This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
A63G 31/02, 31/16, G09B 9/02, G05B 17/02

A1

(11) International Publication Number: WO 97/15363

(43) International Publication Date: 1 May 1997 (01.05.97)

(21) International Application Number: PCT/AU96/00643

(22) International Filing Date: 14 October 1996 (14.10.96)

(30) Priority Data:
PN 6132 20 October 1995 (20.10.95) AU

(71) Applicant *(for all designated States except US)*: SIMTECH AUSTRALIA PTY. LTD. [AU/AU]; 15 Ackland Avenue, Stirling, S.A. 5152 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: CARTWRIGHT, Colin, Edward [AU/AU]; 15 Ackland Avenue, Stirling, S.A. 5152 (AU).

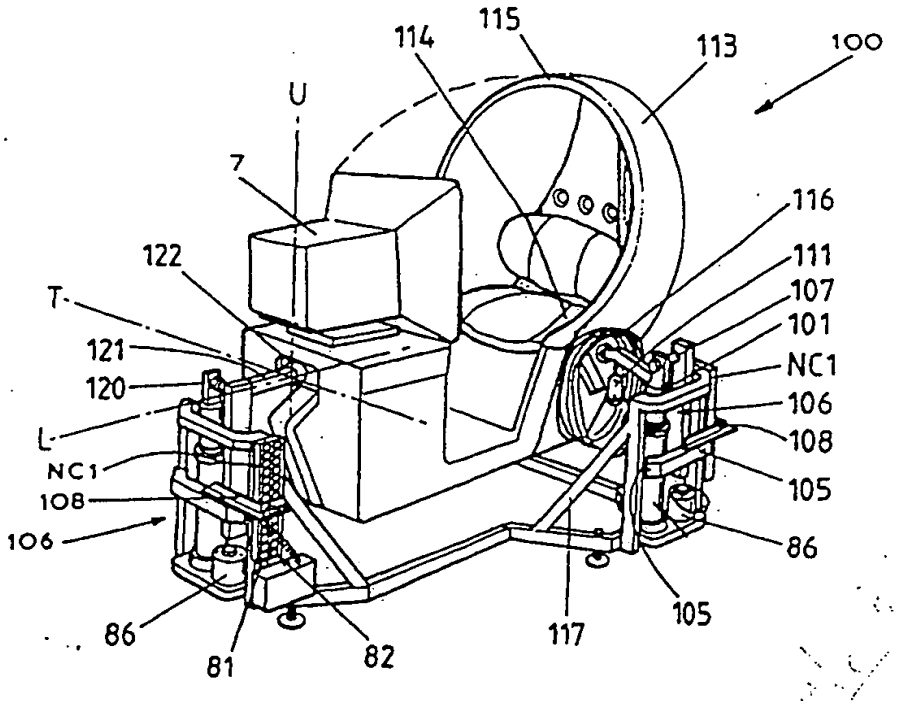
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: SYSTEM AND METHOD FOR CONTROLLING A SIMULATOR ASSEMBLY

(57) Abstract

A system (1) for controlling one or more actuators for providing movement of a simulator assembly. The system (1) includes a processor (6) for processing movement request signals generated from a movement signalling unit (5) to thereby provide one or more actuator position request signals. There is also an actuator controller (3) in communication with the processor (6) to thereby receive one or more position request signals and control directional movement of the actuators in accordance with the position request signals. The system (1) also has an actuator position detector (4) associated with a respective one of the actuators when a requested position is reached in accordance of the position request signals, wherein in use when the actuator position detector (4) detects that the requested position has been reached, the actuator controller (3) disallows movement of said one or more actuators until another movement request signal is generated.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgystan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

SYSTEM AND METHOD FOR CONTROLLING A SIMULATOR ASSEMBLY

FIELD OF INVENTION

THIS INVENTION relates to a system and method for controlling one or more actuators of a simulator assembly and in particular, but not necessarily limited to, controlling actuators associated with a simulator assembly which can be used in conjunction with a personal computer or any other processor.

In another aspect, this invention relates to a user controllable movement signalling means for controlling one or more actuators of a simulator assembly.

BACKGROUND ART

Simulators are commonly used for entertainment or training purposes. One basic form of simulator is generally used in the home in which a personal computer displays images upon a Visual Display Unit (VDU). The simulator is controlled by a computer program in which images are displayed to the VDU by communication with a joystick, keypads or other user controllable movement signalling means to provide an illusion of, for instance, piloting an aircraft (flight simulation) or driving a vehicle(i.e. motor racing simulation).

In general, one problem with simulators of this type used in the home is that the reality of simulation is limited as they do not usually have a means of providing movement in conjunction with images displayed on the VDU.

Due to cost limitations, simulator assemblies used in amusement arcades generally provide movement about a single axis. Simulator assemblies can provide movement about two of three axis, the three axis being a longitudinal, a transverse and a vertical axis. The rotations about these three axes provide simulated roll, pitch and yaw respectively. Such simulator assemblies are relatively expensive, large, heavy and are neither suited for home use or arcades.

Further to the above, simulator assemblies have been developed and used which provide simulated roll, pitch and yaw. Examples of which are disclosed in patent specifications GB 154860 and US 4584869. However, such simulators are relatively expensive, have unnecessary complex support and actuation mechanisms, and require relatively large

amounts of space which is not always available in the home and is an undesirable overhead in amusement arcades. For these reasons simulators which provide simulated roll, pitch and yaw are generally only found at amusement parks, fair grounds or in training institutions such as an aircraft pilot training centre.

In the inventor's patent specification identified by WO 94/24651 there is disclosed a simulator assembly which alleviates some of the problems associated with prior art simulator assemblies. However, the systems and methods for controlling actuators may require complex processing as is the case with conventional prior art simulator assemblies. In this regard prior art systems and methods use dedicated software specifically designed to control directional movement of actuators wherein the software also controls graphical simulation representations on a VDU. As a result, prior art systems and methods are usually software and platform specific and require expensive, high speed processors with large amounts of memory in order to adequately control the actuators during simulation. Accordingly, systems and methods for controlling simulator assembly actuators in accordance with graphical simulation representations are expensive or impractical for the majority of platforms (such as personal computers or dedicated hardware simulator processors for home use). Further, the need for expensive processors and large memorys limits the reality of simulation.

It is an object of this invention to overcome or alleviate at least one of the problems associated with controlling one or more actuators of a simulator assembly.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a system for controlling one or more actuators for providing movement of a simulator assembly, said system including:

processing means for processing movement request signals generated from a movement signalling means to thereby provide one or more actuator position request signals;

actuator control means in communication with said processing means to thereby receive said one or more position request signals and control directional movement of said one or more actuators in accordance with said one or more position request signals; and

actuator position detection means for detecting when said one or more actuators have reached a requested position in accordance of said

one or more position request signals,

wherein said system is characterised such that in use when said position detection means detects that the requested position has been reached, said actuator control means disallows movement of said one or more actuators until another one of said movement request signals is generated.

The processing means may be pure combination logic, microprocessor based, programmable memory based, firmware or otherwise.

Preferably, said actuator control means may include a plurality of position control switching means activatable by said actuator position detection means.

Suitably, said actuator control means may include sets of spaced conductive pads arranged to be selectively electrically coupled to a respective conductive pickup means of said actuator position detection means.

In another form said actuator control means may include sets of spaced light emitting diodes arranged to be selectively coupled to a respective sensor wherein said actuator position detection means is adapted to selectively affect the coupling of the diodes.

Suitably, said control means may include:

first control means associated with a first one of said actuators for controlling directional movement thereof; and

second control means associated with a second one of said actuators for controlling directional movement thereof.

The control means may include a third control means associated with a third one of said actuators for controlling directional movement thereof.

Preferably, said actuator position detection means may include:

first position detection means associated with said first position control means; and

second position detection means associated with said second position control means.

The actuator position detection means may include a third position control means associated with said third position detection means.

Preferably, said first and said second position detection means maybe operatively coupled to a respective actuator of a simulator assembly.

Preferably, said third position detection means is operatively

coupled to a respective actuator of a simulator assembly

Preferably, said system may include said movement signalling means in communication with said processing means.

Suitably, said movement signalling means may be controllable by a person using said simulator assembly.

Preferably, said movement signalling means may comprise a plurality of switch means for generating digitised said request signals, wherein at least some of said switch means are arranged to be actuated sequentially. Alternatively, said movement signalling means may comprise one or more variable resistors for generating one or more analogue signals; and one or more analogue to digital conversions coupled to said resistor(s) for providing digital request signal(s) corresponding to said analogue signal(s).

The switch means may be mechanical, optical or otherwise.

Suitably, said movement signalling means may be adapted such that when operated said request signals are always different to that of when said movement signalling means is at a biassed rest position.

Preferably, said movement signalling means may include processor signalling means for providing one or more processor signals to a processor adapted to control graphical simulation representations displayed on a visual display unit in response to said processor signals. The processor signalling means may be adapted to generate analogue or digital signals.

According to another aspect of the invention there is provided a method for controlling one or more actuators for providing movement of a simulator assembly in conjunction with representations on a visual display unit, said representations being determined by interactive graphical software adapted to respond to signals generated from a user controllable movement signalling means, said method including the steps of:

processing movement request signals generated from a movement signalling means to thereby provide one or more actuator position request signals; and

controlling directional movement of said one or more actuators in accordance with said one or more position request signals,

wherein the step of controlling is effected independently of said software.

According to another aspect of the invention there is provided a method for controlling one or more actuators of a simulator assembly, said

method including the steps of:

processing digital movement request signals to provide one or more actuator position request signals;

controlling directional movement of said one or more actuators in accordance with said one or more actuator position request signals; and

detecting when said one or more actuators have reached a requested position in accordance of said one or more position request signals,

wherein when the step of detecting determines that said one or more actuators have reached said requested position movement thereof is disallowed until a different one of said movement request signals is processed.

Suitably, the method may be further characterised by the prior step of generating said digital movement request signals in response to activation of a user controlled signalling means, said user controlled signalling means also providing signals to interactive graphical software.

Preferably the method may be effected upon a system as described herein above.

According to another aspect of the invention, there is provided a user controllable movement signalling means for controlling one or more actuators of a simulator assembly, the movement signalling means being adapted to provide two signals one of which is for interacting with graphical software for providing visual representation on a visual display unit and the other of the signals being a digital signal for controlling directional movement of said one or more actuators.

According to another aspect of the invention there is provided a system for controlling one or more actuators for providing movement of a simulator assembly in conjunction with representations on a visual display unit, said representations being determined by interactive graphical software adapted to respond to signals generated from a user controllable movement signalling means, said system including:

processing means for processing movement request signals generated from a movement signalling means to thereby provide one or more actuator position request signals; and

actuator control means in communication with said processing means to thereby receive said one or more position request signals and control directional movement of said one or more actuators in accordance

with said one or more position request signals,

wherein said system is adapted to control direction movement of said one or more actuators independently of said software.

Suitably, there may be actuator position detection means associated with said one or more actuators for detecting when said one or more actuators have reached a requested position in accordance of said one or more position request signals.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily understood and put into practical effect reference will now be made to a preferred embodiment illustrated in the accompanying drawings in which:-

FIG 1 is a block diagram of a system for controlling actuators of a simulator assembly,

FIG 2 illustrates a perspective view of an accelerator unit which can be used in the system of FIG 1,

FIG 3 illustrates a perspective view of a brake unit which can be used in the system of FIG 1,

FIG 4 illustrates a perspective view of a steering unit which can be used in the system of FIG 1,

FIG 5 illustrates a rear view of the steering unit of FIG 4,

FIG 6 illustrates a perspective view of a joy stick unit which can be used in the system of FIG 1,

FIG 7 is a perspective view of a throttle unit which can be used in the system of FIG 1,

FIG 8 is a plan view of a rudder control unit when in a rest position which can be used in the system of FIG 1,

FIG 9 is a further plan view of the rudder control unit when moved away from the rest position,

FIG 10 is a illustrated a schematic diagram of switch contacts of FIGS 2 to 9,

FIG 11 is a schematic diagram of a first processing module which can be used in the system of FIG 1,

FIG 12 is a schematic diagram of a first actuator control module and actuator position detection unit which can be used in the system of FIG 1,

FIG 13 is a perspective view of a simulator assembly which can be controlled by the invention as illustrated in FIGS 1 to 12,

FIG 14 is a side view of the simulator assembly of FIG 13,

FIG 15 is a rear view of a simulator assembly of FIG 13, and

FIG 16 is a flow diagram illustrating the method of how the invention controls the simulator assembly of FIG 13.

APPENDIX I illustrates the code programmed into EPROM UNITS of a processing means forming part of FIG 1

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG 1 there is illustrated a block diagram of a system 1 for controlling actuators of a simulator assembly, system 1 includes processing means 2 in communication with an actuator control means 3 and actuator position detection means 4 operatively coupled to actuator control means 3.

The system 1 is coupled to a movement signalling means 5 such that processing means 2 receives movement request signals generated from signalling means 5 which is also in communication with a processor 6. Interactive graphical software controls processor 6 to control graphical simulation representations displayed on a visual display unit 7 ((VDU) in response to signals generated from signalling means 2. Examples of processor 6 are personal computers or any other suitable platforms, for example, dedicated hardware for running simulator games on a VDU which are commonly known under the trade marks Sega, Nintendo, Atari, etc. In another form the dedicated hardware may form part of a simulator and associated assembly used in an amusement arcade or other entertainment establishments.

Referring to FIGS 2 to 9 there is illustrated the movement signalling means 5 which may comprise an accelerator unit 8, brake unit 9 and a steering unit 10 when for example motor racing simulation is required. However if, for instance, flight simulation is required then movement signalling means 5 may comprise a joystick unit 11, throttle unit 12 and rudder control 13.

Accelerator unit 8 illustrated in FIG 2 comprises a lever 14 activatable by a foot pedal (not shown) mountable to lever 14 at aperture 14a. Lever 14 is pivotally mounted about pivot pin 16 to support brackets 15 extending from a base member 15a and biased to the illustrated rest position by a coil spring 17. A cog 18 is also pivotally mounted about pivot pin 16 to brackets 15 and cog 18 is operatively coupled to a cog 19 associated with a shaft of a standard three terminal potentiometer 20 (variable resistor).

Accordingly, cog 18 moves in unison with lever 14 about pin 16. A further cog 21 is operatively coupled to cog 19, and cog 21 is associated with a shaft of a rotary oak switch 22 comprising a plurality of switch contacts A0 to A5 which provide six switches in conjunction with a common wiper arm 23 and an annular conductive common rail 23a. Thus when lever 14 pivots about pin 16 a varying resistance can be obtained from potentiometer 20 and switch contacts A0 to A5 will be activated sequentially,in which rotary oak switch 22 is a make before brake switch. Brake unit 9 illustrated in FIG 3 is identical to accelerator unit 8 and accordingly all components are numbered identically to that of accelerator unit 8 except switch contacts of oak switch 22 are numbered A6 to A11.

Steering unit 10 illustrated in FIGS 4 and 5 comprises a steering wheel 24 mounted to a shaft 25 to which is also mounted to a cam 26. A three terminal potentiometer 28 is mounted to a bracket (not shown for clarity), to which is also mounted right actuator switches 29, 30 and left actuator switches 31, 32.

Switches 29, 30, 31 and 32 are in contact with cam 26 and are open circuit in the rest position of steering unit 10 as illustrated. However, full permitted rotation of shaft 25 by use of wheel 24 in one direction will cause one or both of switches 29 and 30 or alternatively 31 and 32 to become closed. In addition, rotation of shaft 25 causes a varying resistance of potentiometer 28. To allow shaft 29 and thereby cam 26 to return to the rest position there are springs 27 attached at one end to the bracket not shown and the other ends are attached to a lug 27a which is mounted to shaft 25. The outputs of right actuator switches 29, 30 are identified by A12R and A13R which are electrically connected to a first processing unit of processing means 2 which is associated with an actuator of a simulator assembly. Similarly, the outputs of the left actuator switches 31, 32 are also identified by A12L and A13L, and are connected to a second processing unit of processing means 2 which is associated with another actuator of the simulator assembly.

Joystick unit 11 illustrated in FIG 6 comprises a Joystick lever 33 pivotally mounted to frame 34 about a pivot pin 35. Frame 34 is pivotally mounted to bracket 36 by pivot pins 34a one of which is coupled to a shaft of a forward/back three terminal potentiometer 37 mounted to bracket 36 and the other of pins 34a is coupled to a cog assembly 38a associated with a forward/back rotary oak switch 38 mounted to bracket 36.

Attached to frame 34 are opposing springs 39 which are mounted to bracket 36 and bias frame 34 to the rest position as illustrated.

Frame 34 has a slot 40 through which Joystick lever 33 extends and protrudes into a slot 41 in a pivotal member 42 which is pivotally mounted to bracket 36 about two pivot pins 42a one of which is coupled to a left/right three terminal potentiometer 43 mounted to bracket 36 and the other of pins 42a is coupled to a cog assembly 44a associated with a left/right oak switch 44 mounted bracket 36.

Attached to pivotal member 42 are opposed springs 45 which are mounted to bracket 36 and bias pivotal member 42 to the rest position as illustrated. Accordingly, Joystick lever 33 can be pivotally operated in both left/right and forward/back (down/up) directions whilst operating potentiometers 37, 43 and oak switches 38, 44 thereby varying the resistance values of potentiometers 37, 43 and selectively opening and closing switch contacts of oak switches 38,44. Rotary oak switch 38 has a common contact and six switch output contacts A0 to A5 which in the rest position as illustrated contacts A2 and A3 are closed and A0, A1, A4 and A5 are open. When Joystick lever 33 is fully forward switch contact A0 is closed and contacts A1 to A5 open. When Joystick lever 33 is fully back switch contact A5 is closed and A0 to A4 open. The rotary oak switch 38 is a make before brake switch therefore as lever 33 is moved forward the next contact A1 is closed before A2 is opened. Similarly when lever 33 is moved backwards A4 is closed before A3 is opened.

Rotary oak switch 44 is also a make before brake switch has a common contact and six switch output contacts A6L, A7L, A8L, A6R, A7R and A8R. In the central position as illustrated switch contacts A6L to A8L and A6R or A8R are open. When Joystick lever 33 is fully left A6L is closed and all others are open and when Joystick lever is fully right A6R is closed and all others open.

Also mounted to bracket 36 are two rows of switches 39a, 39b, switches 39a have a flexible activation arm which is operatively coupled to frame 34 and there are four switch contacts SW3, SW4, SW5, SW6 associated with switches 39a all of which are open in the rest position. However, if joystick lever 33 is pivoted left then SW3 and SW5 will close and if pivoted right SW4 and SW6 will close. Switches 39b have a flexible activation arm which is operatively coupled to pivotal member 42 and there are two switch contacts SW1, SW2 associated with switches 39b. In the rest

position SW1 is open and SW2 is closed. SW1 will remain open during forward movement from the rest position of joystick lever 33 (SW2 remaining closed). If joystick lever 33 is pulled in the reverse direction from the rest position SW1 will close and SW2 will open.

Throttle unit 12 illustrated in FIG 7 is similar to accelerator unit 8 except that lever 14 is hand operated and switch contacts of oak switch 22 are numbered A9 to A13. Accordingly, all of the components of throttle unit 12 are numbered the same as accelerator unit 8 in which in the rest position all switch output contacts A9 to A13 are open.

Rudder control unit 13 illustrated in FIGS 8 and 9 comprises a base 50 to which are pivotally mounted two parallel levers 51, 52. Lever 51 is pivotally mounted about a pivot pin 53 which has an associated cog 54 operatively coupled to cogs 55, 56 on respective shafts 57, 58 of rudder potentiometer 59 and rudder rotary oak switch 60 which are mounted on base 50. Lever 52 is pivotally mounted about pivot pin 61 and pedals 62, 63 bridge levers 51, 52 wherein each of pedals 62, 63 are pivotally mounted to respective levers 51, 52 about pivot pins 64.

Adjustable springs (not shown) mounted to frame 50 around pivot pin 61 bias levers 51, 52, in a rest position as illustrated.

Rotary oak switch 60 is a make before brake switch and has switch contacts A7L, A8L, A7R and A8R which are all open in the rest position. When left rudder pedal 63 is pushed forward to a maximum left position as illustrated by in FIG 9 switch contacts A7L are closed and contacts A8R, A7R and A8L are open. Alternatively, when right rudder pedal 62 is pushed forward switch contacts A7R are closed and contacts A8R, A7L, A8L open. Similarly, potentiometer 59 will vary in resistance during operation of rudder control unit 13.

Illustrated in FIG 10 is a schematic electrical diagram of contacts A0 to A13 of signalling means 5 when in a rest position. Also shown are electrical connections of signalling means 5 to plug in connectors HMR1, HML1, HMF1, HMR2, HML2 and HMF2.

As illustrated, HMR1, HML1 and HMF1 are for use when, for example, motor racing simulation is required, whereas HMR2, HML2 and HMF2 are for use when flight or space travel simulation are required. To provide a distinguishing signal to processing means 2, A14 of each connector HMR2, HML2 and HMF2 are connected to + 5 volts.

In use, either the set of connectors, HMR1, HML1 and HMF1

will be plugged into respective connectors of processing means 2 or alternatively the set of connectors HMR2, HML2 and HMF2 may be plugged into the respective connectors of processing means 2. However, by suitable switching (i.e., by multiplexing) either set could be connected to a respective connector of processing means 2 without the need for physical unplugging and plugging.

Referring to FIG 11 there is illustrated a first processing module 70 of processing means 2, first processing module 70 is for controlling a right actuator RA of a simulator assembly. Module 70 comprises four EPROMS U1, U2, U3 and U4 having 15 address lines A0 to A14 electrically connected to a socket S1 for connection to A0 to A14 of plug HMR1 or alternative HMR2 as described in FIG 10. All address lines A0 to A14 and outputs of EPROMS U1 to U4 are coupled to ground by 10K ohm pull-down resistors and inputs E, G of each EPROM U1 to U4 are directly connected to ground. EPROMS U1 and U2 have combined outputs DQ1 and DQ13 which provide a thirteen bit data bus associated with supplying a binary controlling code for movement of right actuator RA of a simulator assembly in an upward direction only. Similarly, EPROMS U3 and U4 have combined outputs Q1 to Q13 which provide a thirteen bit data bus associated with supplying a binary code for controlling right actuator RA in a downward direction only.

Both data buses DQ1 to DQ13 and Q1 to Q13 are electrically connected to a 26 pin socket H1A via diodes D1 to D26.

There is also a second processing module 71 of processing means 2 for controlling a left actuator LA of the simulator assembly which is identical to module 70 and is therefore not illustrated, however, socket S1 of module 71 is connected to plug HML1 or alternatively HML2. Further, there is a third processing module 72 of processing means 2 for controlling a front actuator FA which again is identical to module 70 and therefore is not illustrated, however, socket S1 of module 72 is connected to plug HMF1 or alternatively HMF2.

Referring to FIG 12 there is illustrated a first actuator control module 80 comprising one part of actuator control means 3 for controlling directional movement of right actuator RA. Control module 80 comprises an upward signalling set of aligned spaced conductive pads 81 and a downward signalling set of aligned spaced conductive pads 82. Pads 81, 82 are mounted on an electrically non-conductive substrate NC1. There are 13 of pads 81 each one being electrically connected in the order as shown to an

individual one of data bits DQ1 to DQ13 of plug H1B which is plugged into socket H1A of module 70. Similarly, there are 13 pads 82 each one being electrically connected in the order shown to an individual one of data bits Q1 to Q13 of H1B. Also shown is first actuator position detection unit 83 of actuator position detection means 4 for detecting the position of right actuator RA. Unit 83 in this embodiment comprises a respective conductive brushes (conductive pickups) 84, 85 arranged to move up and down respective pads 81, 82 during upward or downward movement of right actuator RA. Conductive brush 84 is electrically connected to a base electrode of a transistor T1 via a 10k ohm resistor R31 and diode D31 and a pull-down resistor R30 is connected at a common node of R31 and D31. Emitter electrode of Transistor T1 is directly connected to ground and the collector electrode of Transistor T1 is connected to one side of a coil of a relay RL1 the other side of which is connected to 24 volts via a 100 ohm resistor. Relay contacts of RL1 are electrically configured when energised to provide 24 volts D.C. to a right actuator motor 86 which is operatively coupled to drive right actuator RA.

Conductive brush 85 is electrically connected to a base electrode of Transistor T2 via a 10 k ohm resistor R33 and Diode D32 and a pull-down resistor R32 is connected to a common node of R33 and D32. Emitter electrode of transistor T2 is directly connected to ground and the collector electrode of transistor T2 is connected to one side of a coil of a relay RL2 the other side of which is connected to 24 volts via a 100 ohm resistor. Relay contacts of RL2 are electrically configured when energised to provide 24 volts D.C. to right actuator motor 86 in reverse polarity to relay contacts of relay RL1 when energised.

There is also a second actuator control module 88 comprising a part of actuator control means 3 for controlling directional movement of left actuator LA and a second actuation position detection unit 89 of position detection means 4. Module 88 is identical to module 80 and is not illustrated to avoid repetition, however, conductive pickup arms 84, 85 of unit 89 are arranged to move up and down respective pads 81, 82 during upward or downward movement of left actuator LA. In this regard, pads 81 and 82 are connected via plug H1B to socket H1A of module 71. Furthermore motor 86 of module 88 is a left actuator motor which is operatively coupled to drive left actuator LA.

There is also a third actuator control module 90 comprising part

of actuator control means 3 for controlling directional movement of front actuator FA and a third actuation position detection unit 91 of position detection means 4 detecting the position of front actuator FA. Module 90 is identical to module 80 and is therefore not illustrated. However, conductive pickup arms 84, 85 of unit 91 are arranged to move up and down respective pads 81, 82 during upward or downward movement of front actuator FA. In this regard, pads 81 and 82 are connected via plug H1B to socket H1A of module 72. Furthermore motor 86 of unit 90 is a front actuator motor which is operatively coupled to drive front actuator FA.

In FIGS 13 to 15 there is illustrated an example of simulator assembly 100 which can be controlled by system 1. Assembly 100 includes left actuator (LA) 101 which is a linear drive operatively coupled to motor 86. There is also illustrated a carriage track 102, associated with left actuator 101, comprising two upright members 103 mounted to a base 104. Mounted to one of the upright members 103 is non-conductive substrate NC1 and associated conductive pads 81, 82 of control module 88. Mounted on track 102 by rollers 105 is a carriage 106 comprising a vertical member 106a and cross members 106b. Rollers 105 are rotatably mounted to respective cross members 106b to allow movement of carriage 106 along track 102. Carriage 106 is mounted to left actuator 101 by a bolt 107. Movement of actuator 101 causes upward or downward movement of carriage frame 106 along track 102 and mounted to frame 106 is a bracket 108 to which are mounted conductive brushes 84, 85 mounted in non electrically conductive mounts. Brushes 84,85 are operatively coupled to the actuator and positioned to selectively contact respective conductive pads 81, 82 of second actuator control module 88 during movement of carriage frame 106 along track 102.

Right actuator (RA) 109 of assembly 100 has an associated assembly comprising track 102, carriage frame 106, and mounted to frame 106 is a bracket 108 to which are mounted conductive brushes 84, 85 mounted in non electrically conductive mounts. Brushes 84,85 are operatively coupled to the actuator and positioned to selectively contact respective conductive pads 81, 82 which is similar to the assembly associated with left actuator 101. Extending from each carriage frame 106 associated with respective actuators 101,109 is an arm 110 to which is pivotally mounted to a respective pulley 111.

Two multi stranded flexible cables 112 (commonly known as aircraft cable) are attached at one end to base frame 104 and each engage a

respective pulley 111. The other ends of cables 112 are coupled to rear sides of a user support member 113 which includes simulator assembly seat 114 and sensory isolation cover 115. Springs 116 extend between user support member 113 and respective right and left support struts 117 associated with right and left tracks 102 and reduce rocking of support member 113. Springs 116 have a webbing to cover pulleys 111 and arm 110.

Spaced longitudinally from actuators 101, 109 is a front actuator (FA) 120 mounted to base frame 104. Front actuator 120 has an associated assembly of track 102, carriage frame 106, and mounted to frame 106 is a bracket 108 to which are mounted conductive brushes 84, 85 mounted in non electrically conductive mounts. Brushes 84,85 are operatively coupled to the actuator and positioned to selectively contact respective conductive pads 81, 82 and are similar to the assembly associated with left actuator 101.

Extending from front actuator 120 is a rigid arm 121 which is pivotally attached by a ball joint assembly 122 to front part of user support member 113. Ball joint 122 assembly allows user support member 113 to pivot about an upright axis U, a longitudinal axis L and a transverse axis T. In this regard movement of only right actuator 109 or only left actuator 101 provides movement of user support member 113 about upright axis U and longitudinal axis L. Concurrent movement in the same direction of both left and right actuators 101, 109 provides movement of user support member 101 about transverse axis T.

When movement of left and right actuators 101, 109 occurs concurrently in opposite directions movement about upright axis U and increased movement about the longitudinal axis is also provided. This therefore allows the two actuators 101 and 109 to provide roll, pitch and yaw to user support member 113. Furthermore movement of front actuator 120 in combination with relative movement of one or both actuators 101 and 109 increases the range of roll, pitch, yaw and combinations thereof.

Referring to FIG 16 there is illustrated a flow diagram of the system of FIG 1 when in use. As shown at step 150 movement signalling means 5 generates two signals, one being an analogue signal generated from potentiometers as described above the other being a digital signal from the switches which generate signals A0 to A13. The analogue signal is sent at step 151 to processor 6 for interactive communication to control visual representations on VDU 7 by use of interactive graphical software. The

signals A0 to A13 are supplied to processing means 2 at step 152 to thereby provide one or more actuator position request signals. At step 153 one or more of actuators 101, 109 and 120 are controlled in accordance with the position request signals and step 154 detects when the respective one or more actuators 101, 109 and 120 have reached the position indicative of the position request signals which thereby stops further movement of one or more of actuators 101, 109 and 120. The steps are repeated each time position request signals are generated at step 150. However, if a new signal is generated before position detection means 4 detects that one or more actuators 101, 109 and 120 have reached the position indicative of the position request signals then the actuators 101, 109, 120 will move in accordance with the newly generated position request signal(s).

The method and system as described above allows the controlling of one or more actuators 101, 109 and 120 independent of interactive graphical software. Accordingly, the invention can be used on numerous platforms , complex and computationally expensive software is not required to control the actuators during simulation. In this regard, the invention may be used in conjunction with existing interactive graphical software used on computers and other platforms in which the software is not adapted to provide movement commands to actuators.

Appendix I illustrates the functionality of processing means 2 for actuators 101, 109 and 120. As illustrated by block 1 columns A0 to A14 correspond to inputs A0 to A14 of processing means 2. Furthermore each row Q and DQ are cross referenced with columns of output numbers 1 to 13 and refer to the outputs Q1 to Q13 and DQ1 to DQ13. For example, output column 13 when cross referenced with row DQ refers to output DQ13, and when output column 13 is cross referenced with row Q this refers to output Q13. Block 1 also shows hexidecimal inputs A0 to A14 which is equivalent to binary inputs A0 to A14, hexidecimal outputs 13 to 6 and 5 to 1 that are hexidecimal equivalents of respective binary outputs 13 to 6 and 5 to 1. For example, hexidecimal inputs Ao to A14 of 0020 is equivalent to binary inputs A0 to A14 being set to 00000000100000 and hexidecimal outputs 13 to 6 of 7F is equivalent to binary output 13 to 6 of 1111111. Although this will be apparent to a skilled addressee, both binary numbers and hexidecimal numbers are illustrated in Block 1, whereas all subsequent blocks only illustrate hexidecimal values.

Blocks 1 to 36 are for controlling a respective one of left and

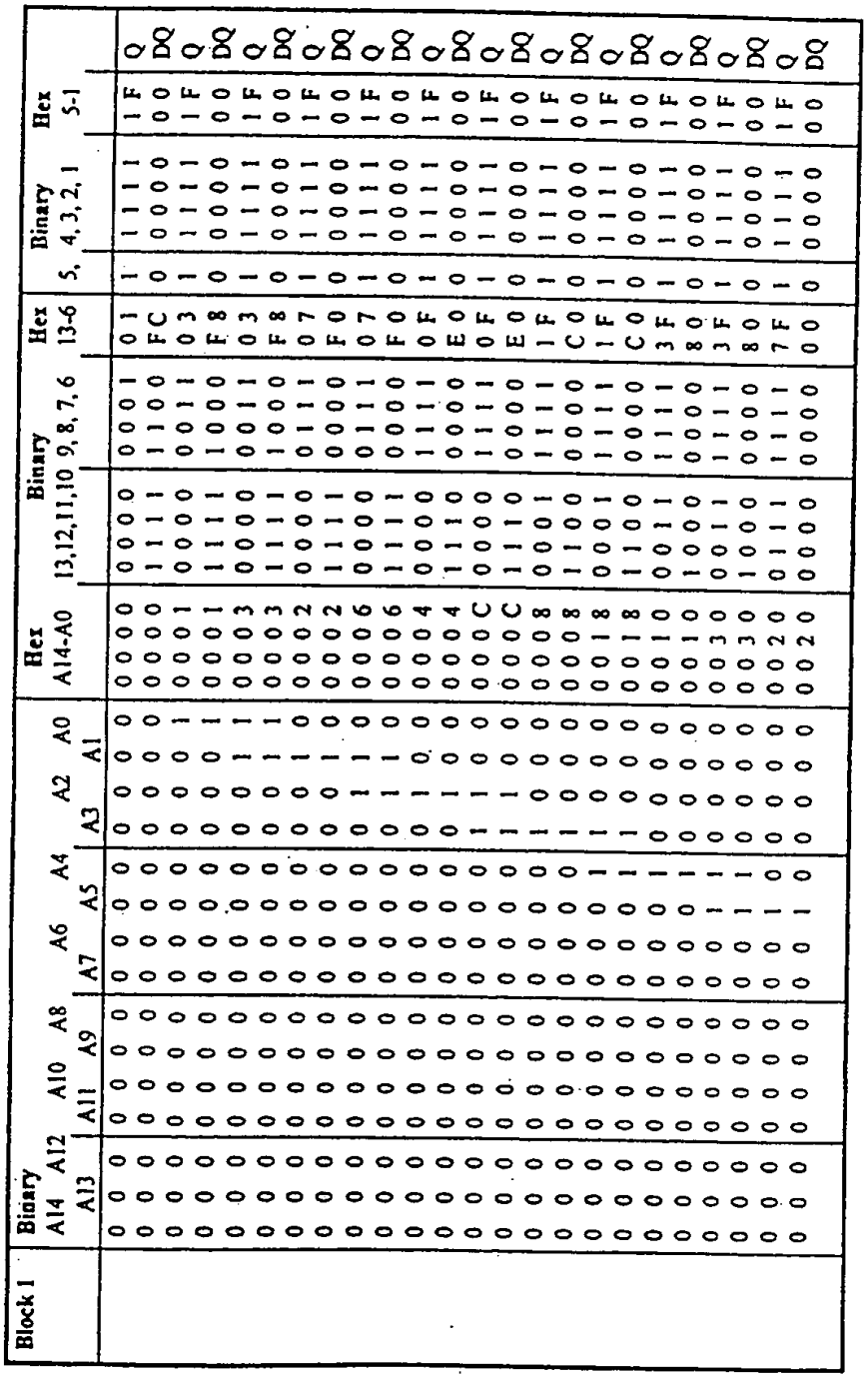
right actuators 101, 109, for motor racing or vehicle simulation. Referring to BLOCK 1, when all switch contacts A0 to A14 are open (logic 0 which corresponds to the first two rows of Block 1), Q7 and DQ7 which relates to the middle pads 81, 82 associated with each actuator 101, 109 are at logic 0. Further, outputs DQ13 to DQ8 are logic 1, Q13 to Q8 are logic 0, DQ6 to DQ1 are logic 0 and Q6 to Q1 are logic 1. This corresponds to hexidecimal outputs 13 to 6 for Q having a value of 01, hexidecimal outputs 5 to 1 for Q having a value of 00, hexidecimal outputs 13 to 6 for DQ having a value of FC and hexidecimal outputs 5 to 1 for DQ having a value of 00 . Accordingly, the logic values applied to pads 82, 83 of both left and right control modules will energise respective relays RL1 or RL2 when pickups 84, 85 are not contacting pads DQ7, Q7 and therefore electrical current will be supplied to one or both motors 86 of left or right actuators 101, 109 resulting in respective pickups 84, 85 moving towards a mid position indicative of the position of pads 81, 82 connected to DQ7 and Q7.

When pickups 84, 85 reach pads DQ7 and Q7 of a respective left or right actuator 101, 109 energised relay RL1 or RL2 will de-energise and the associated actuator 101,109 will stop moving. However, if a different combination of open and closed switch contacts A0 to A13 occurs before position DQ7, Q7 of left and right actuators 101, 109 is reached then respective motor(s) 86 will be controlled accordingly by the logic values appearing on associated pads 81, 82. In this regard BLOCK 1 illustrates the logic condition of each of pads DQ1 to DQ13, Q1 to Q13 of modules 80, 88 when accelerator unit 8 is activated thereby switching contacts A0 to A5. Similarly blocks 2 to 12 illustrate the logic conditions of pads DQ1 to DQ13, Q1 to Q13 of modules 80, 88 when brake unit 9 is activated thereby switching contacts A6 to A11 in combination with A0 to A5 controlling accelerator unit 8. Further blocks 13 to 36 illustrate the logic condition of each of DQ1 to DQ13, Q1 to Q13 of modules 80, 88 when steering unit 10 is used to switch contacts A12, A13 in combination with A0 to A11 of accelerator unit 8 and brake unit 9.

Blocks 37 to 48 illustrate the logic condition in each of DQ1 to DQ13, Q1 to Q13 of module 90 which is associated with controlling motor 86 of front actuator 120 during motor racing simulation or vehicle simulation. In this regard, activation of accelerator unit 8 provides upward movement of front actuator 120 and activation of brake unit 9 provides downward movement of front actuator 120.

Blocks 49 to 62 are applicable to flight simulation and space travel simulation mode and is distinguished from driving or logic 1 being constantly applied to A14. In particular, blocks 49 to 54 relate to controlling left and right actuators 101, 109 via respective pads 81, 82 and pickups 84, 85 whereas blocks 55 to 62 relate to controlling front actuator 120 via respective pads 81, 82 and pickups 84, 85.

Although the invention has been described with reference to a preferred embodiment, it is to be understood that the invention is not limited to the specific embodiment described herein. For example, the potentiometers associated with movement signalling means 5 may be replaced with switches in which analogue signals are then supplied to processor 6. Also, the switches of movement signalling means 5 which control the logic values of A0 to A14 may be substituted by potentiometers and then coupled through analogue to digital converters to thereby supply logic values A0 to A14. Finally, it should be also apparent to a skilled addressee that the invention is not limited to the specific embodiment as described herein. For example, the invention may be used to control the simulator assembly and associated actuators as described in inventor's earlier patent specification identified by WO 94/24651.



APPENDIX 1

	Block 2 Hex			Block 3 Hex			Block 4 Hex			Block 5 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0040	01	1F	00C0	01	1F	0080	01	1F	0180	00	11
DQ	0040	FC	00	00C0	FC	00	0080	FC	00	0180	F0	C0
Q	0040	01	1F	00C1	01	1F	0081	01	1F	0181	00	11
DQ	0041	FC	00	00C1	FC	00	0081	FC	00	0181	F0	C0
Q	0041	01	1F	00C3	01	1F	0083	01	1F	0183	00	11
DQ	0043	FC	00	00C3	FC	00	0083	FC	00	0183	F0	C0
Q	0043	03	1F	00C2	03	1F	0082	01	1F	0182	00	11
DQ	0042	F8	00	00C2	F8	00	0082	FC	00	0182	F0	C0
Q	0042	03	1F	00C6	03	1F	0086	01	1F	0186	00	11
DQ	0046	F8	00	00C6	F8	00	0086	FC	00	0186	F0	C0
Q	0046	07	1F	00C4	07	1F	0084	03	1F	0184	00	31
DQ	0044	F0	00	00C4	F0	00	0084	F8	00	0184	F0	80
Q	0044	07	1F	00CC	07	1F	008C	03	1F	018C	00	31
DQ	004C	F0	00	00CC	F0	00	008C	F8	00	018C	F0	80
Q	004C	0F	1F	00C8	0F	1F	0088	07	1F	0188	00	71
DQ	0048	E0	00	00C8	E0	00	0088	F0	00	0188	F0	00
Q	0058	0F	1F	00D8	0F	1F	0098	07	1F	0198	00	71
DQ	0058	E0	00	00D8	E0	00	0098	F0	00	0198	F0	00
Q	0058	1F	1F	00D0	1F	1F	0090	0F	1F	0190	00	F1
DQ	0050	C0	00	00D0	C0	00	0090	E0	00	0190	E0	00
Q	0070	1F	1F	00F0	1F	1F	00B0	0F	1F	01B0	00	F1
DQ	0070	C0	00	00F0	C0	00	00B0	E0	00	01B0	E0	00
Q	0060	3F	1F	00E0	3F	1F	00A0	1F	1F	01A0	10	F1
DQ	0060	80	00	00E0	80	00	00A0	C0	00	01A0	C0	00

	Block 6 Hex			Block 7 Hex			Block 8 Hex			Block 9 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0100	01	1F	0300	01	1F	0200	01	1F	0600	01	1F
DQ	0100	FC	00	0300	FC	00	0200	FC	00	0600	FC	00
Q	0101	01	1F	0301	01	1F	0201	01	1F	0601	01	1F
DQ	0101	FC	00	0301	FC	00	0201	FC	00	0601	FC	00
Q	0103	01	1F	0303	01	1F	0203	01	1F	0603	01	1F
DQ	0103	FC	00	0303	FC	00	0203	FC	00	0603	FC	00
Q	0102	01	1F	0302	01	1F	0202	01	1F	0602	01	1F
DQ	0102	FC	00	0302	FC	00	0202	FC	00	0602	FC	00
Q	0106	01	1F	0306	01	1F	0206	01	1F	0606	01	1F
DQ	0106	FC	00	0306	FC	00	0206	FC	00	0606	FC	00
Q	0104	01	1F	0304	01	1F	0204	01	1F	0604	01	1F
DQ	0104	FC	00	0304	FC	00	0204	FC	00	0604	FC	00
Q	010C	01	1F	030C	01	1F	020C	01	1F	060C	01	1F
DQ	010C	FC	00	030C	FC	00	020C	FC	00	060C	FC	00
Q	0108	03	1F	0308	03	1F	0208	01	1F	0608	01	1F
DQ	0108	F8	00	0308	F8	00	0208	FC	00	0608	FC	00
Q	0118	03	1F	0318	03	1F	0218	01	1F	0618	01	1F
DQ	0118	F8	00	0318	F8	00	0218	FC	00	0618	FC	00
Q	0110	07	1F	0310	07	1F	0210	03	1F	0610	03	1F
DQ	0110	F0	00	0310	F0	00	0210	F8	00	0610	F8	00
Q	0130	07	1F	0330	07	1F	0230	03	1F	0630	03	1F
DQ	0130	F0	00	0330	F0	00	0230	F8	00	0630	F8	00
Q	0120	0F	1F	0320	0F	1F	0220	07	1F	0620	07	1F
DQ	0120	E0	00	0320	E0	00	0220	F0	00	0620	F0	00

APPENDIX 1

	Block 10 Hex			Block 11 Hex			Block 12 Hex			Block 13 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0400	01	1F	0C00	01	1F	0800	01	1F	1000	00	0F
DQ	0400	FC	00	0C00	FC	00	0800	FC	00	1000	FF	00
Q	0401	01	1F	0C01	01	1F	0801	01	1F	1001	00	1F
DQ	0401	FC	00	0C01	FC	00	0801	FC	00	1001	FE	00
Q	0403	01	1F	0C03	01	1F	0803	01	1F	1003	00	1F
DQ	0403	FC	00	0C03	FC	00	0803	FC	00	1003	FE	00
Q	0402	01	1F	0C02	01	1F	0802	01	1F	1002	00	1F
DQ	0402	FC	00	0C02	FC	00	0802	FC	00	1002	FE	00
Q	0406	01	1F	0C06	01	1F	0806	01	1F	1006	00	1F
DQ	0406	FC	00	0C06	FC	00	0806	FC	00	1006	FE	00
Q	0404	01	1F	0C04	01	1F	0804	01	1F	1004	00	0F
DQ	0404	FC	00	0C04	FC	00	0804	FC	00	1004	FF	00
Q	040C	01	1F	0C0C	01	1F	080C	01	1F	100C	00	0F
DQ	040C	FC	00	0C0C	FC	00	080C	FC	00	100C	FF	00
Q	0408	01	1F	0C08	01	1F	0808	01	1F	1008	00	0F
DQ	0408	FC	00	0C08	FC	00	0808	FC	00	1008	FF	00
Q	0418	01	1F	0C18	01	1F	0818	01	1F	1018	00	0F
DQ	0418	FC	00	0C18	FC	00	0818	FC	00	1018	FF	00
Q	0410	01	1F	0C10	01	1F	0810	01	1F	1010	00	07
DQ	0410	FC	00	0C10	FC	00	0810	FC	00	1010	FF	10
Q	0430	01	1F	0C30	01	1F	0830	01	1F	1030	00	07
DQ	0430	FC	00	0C30	FC	00	0830	FC	00	1030	FF	10
Q	0420	03	1F	0C20	03	1F	0820	01	1F	1020	00	07
DQ	0420	F8	00	0C20	F8	00	0820	FC	00	1020	FF	10

	Block 14 Hex			Block 15 Hex			Block 16 Hex			Block 17 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	1040	00	0F	10C0	00	0F	1080	00	0F	1180	00	0F
DQ	1040	FF	00	10C0	FF	00	1080	FF	00	1180	FF	00
Q	1041	00	1F	10C1	00	1F	1081	00	1F	1181	00	1F
DQ	1041	FE	00	10C1	FE	00	1081	FE	00	1181	FE	00
Q	1043	00	1F	10C3	00	1F	1083	00	1F	1183	00	1F
DQ	1043	FE	00	10C3	FE	00	1083	FE	00	1183	FE	00
Q	1042	00	1F	10C2	00	1F	1082	00	1F	1182	00	1F
DQ	1042	FE	00	10C2	FE	00	1082	FE	00	1182	FE	00
Q	1046	00	1F	10C6	00	1F	1086	00	1F	1186	00	1F
DQ	1046	FE	00	10C6	FE	00	1086	FE	00	1186	FE	00
Q	1044	00	1F	10C4	00	1F	1084	00	1F	1184	00	1F
DQ	1044	FE	00	10C4	FE	00	1084	FE	00	1184	FE	00
Q	104C	00	0F	10CC	00	0F	108C	00	1F	118C	00	1F
DQ	104C	FF	00	10CC	FF	00	108C	FE	00	118C	FE	00
Q	1048	00	0F	10C8	00	0F	1088	00	0F	1188	00	0F
DQ	1048	FF	00	10C8	FF	00	1088	FF	00	1188	FF	00
Q	1058	00	0F	10D8	00	0F	1098	00	0F	1198	00	0F
DQ	1058	FF	00	10D8	FF	00	1098	FF	00	1198	FF	00
Q	1050	00	0F	10D0	00	0F	1090	00	0F	1190	00	0F
DQ	1050	FF	00	10D0	FF	00	1090	FF	00	1190	FF	00
Q	1070	00	07	10F0	00	07	10B0	00	07	11B0	00	0F
DQ	1070	FF	10	10F0	FF	10	10B0	FF	00	11B0	FF	00
Q	1060	00	07	10E0	00	07	10A0	00	07	11A0	00	07
DQ	1060	FF	10	10E0	FF	10	10A0	FF	10	11A0	FF	10

APPENDIX 1

	Block 18 Hex			Block 19 Hex			Block 20 Hex			Block 21 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	1100	00	0F	1300	00	0F	1200	00	0F	1600	00	0F
DQ	1100	FF	00	1300	FF	00	1200	FF	00	1600	FF	00
Q	1101	00	1F	1301	00	1F	1201	00	1F	1601	00	1F
DQ	1101	FE	00	1301	FE	00	1201	FE	00	1601	FE	00
Q	1103	00	1F	1303	00	1F	1203	00	1F	1603	00	1F
DQ	1103	FE	00	1303	FE	00	1203	FE	00	1603	FE	00
Q	1102	00	1F	1302	00	1F	1202	00	1F	1602	00	1F
DQ	1102	FE	00	1302	FE	00	1202	FE	00	1602	FE	00
Q	1106	00	1F	1306	00	1F	1206	00	1F	1606	00	1F
DQ	1106	FE	00	1306	FE	00	1206	FE	00	1606	FE	00
Q	1104	00	1F	1304	00	1F	1204	00	1F	1604	00	1F
DQ	1104	FE	00	1304	FE	00	1204	FE	00	1604	FE	00
Q	110C	00	1F	130C	00	1F	120C	00	1F	160C	00	1F
DQ	110C	FE	00	130C	FE	00	120C	FE	00	160C	FE	00
Q	1108	00	1F	1308	00	1F	1208	00	1F	1608	00	1F
DQ	1108	FE	00	1308	FE	00	1208	FE	00	1608	FE	00
Q	1118	00	0F	1318	00	0F	1218	00	1F	1618	00	1F
DQ	1118	FF	00	1318	FF	00	1218	FE	00	1618	FE	00
Q	1110	00	0F	1310	00	0F	1210	00	0F	1610	00	0F
DQ	1110	FF	00	1310	FF	00	1210	FF	00	1610	FF	00
Q	1130	00	0F	1330	00	0F	1230	00	0F	1630	00	0F
DQ	1130	FF	00	1330	FF	00	1230	FF	00	1630	FF	00
Q	1120	00	0F	1320	00	0F	1220	00	0F	1620	00	0F
DQ	1120	FF	00	1320	FF	00	1220	FF	00	1620	FF	00

	Block 22 Hex			Block 23 Hex			Block 24 Hex			Block 25 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	1400	00	0F	1C00	00	0F	1800	00	0F	3000	00	07
DQ	1400	FF	00	1C00	FF	00	1800	FF	00	3000	FF	10
Q	1401	01	1F	1C01	01	1F	1801	01	1F	3001	00	1F
DQ	1401	FC	00	1C01	FC	00	1801	FC	00	3001	FE	00
Q	1403	01	1F	1C03	01	1F	1803	01	1F	3003	00	1F
DQ	1403	FC	00	1C03	FC	00	1803	FC	00	3003	FE	00
Q	1402	01	1F	1C02	01	1F	1802	01	1F	3002	00	0F
DQ	1402	FC	00	1C02	FC	00	1802	FC	00	3002	FF	00
Q	1406	01	1F	1C06	01	1F	1806	01	1F	3006	00	0F
DQ	1406	FC	00	1C06	FC	00	1806	FC	00	3006	FF	00
Q	1404	01	1F	1C04	01	1F	1804	01	1F	3004	00	07
DQ	1404	FC	00	1C04	FC	00	1804	FC	00	3004	FF	10
Q	140C	01	1F	1C0C	01	1F	180C	01	1F	300C	00	07
DQ	140C	FC	00	1C0C	FC	00	180C	FC	00	300C	FF	10
Q	1408	00	1F	1C08	00	1F	1808	01	1F	3008	00	03
DQ	1408	FE	00	1C08	FE	00	1808	FC	00	3008	FF	18
Q	1418	00	1F	1C18	00	1F	1818	01	1F	3018	00	03
DQ	1418	FE	00	1C18	FE	00	1818	FC	00	3018	FF	18
Q	1410	00	1F	1C10	00	1F	1810	01	1F	3010	00	01
DQ	1410	FE	00	1C10	FE	00	1810	FC	00	3010	FF	1C
Q	1430	00	1F	1C30	00	1F	1830	01	1F	3030	00	01
DQ	1430	FE	00	1C30	FE	00	1830	FC	00	3030	FF	1C
Q	1420	00	1F	1C20	00	1F	1820	01	1F	3020	00	00
DQ	1420	FE	00	1C20	FE	00	1820	FC	00	3020	FF	1E

APPENDIX 1

	Block 26 Hex			Block 27 Hex			Block 28 Hex			Block 29 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	3040	00	07	30C0	00	07	3080	00	07	3180	00	07
DQ	3040	FF	10	30C0	FF	10	3080	FF	10	3180	FF	10
Q	3041	01	1F	30C1	01	1F	3081	01	1F	3181	01	1F
DQ	3041	FC	00	30C1	FC	00	3081	FC	00	3181	FC	00
Q	3043	01	1F	30C3	01	1F	3083	01	1F	3183	01	1F
DQ	3043	FC	00	30C3	FC	00	3083	FC	00	3183	FC	00
Q	3042	00	1F	30C2	00	1F	3082	01	1F	3182	01	1F
DQ	3042	FE	00	30C2	FE	00	3082	FC	00	3182	FC	00
Q	3046	00	1F	30C6	00	1F	3086	01	1F	3186	01	1F
DQ	3046	FE	00	30C6	FE	00	3086	FC	00	3186	FC	00
Q	3044	00	0F	30C4	00	0F	3084	00	1F	3184	00	1F
DQ	3044	FF	00	30C4	FF	00	3084	FE	00	3184	FE	00
Q	304C	00	0F	30CC	00	0F	308C	00	1F	318C	00	1F
DQ	304C	FF	00	30CC	FF	00	308C	FE	00	318C	FE	00
Q	3048	00	07	30C8	00	07	3088	00	0F	3188	00	0F
DQ	3048	FF	10	30C8	FF	10	3088	FF	00	3188	FF	00
Q	3058	00	07	30D8	00	07	3098	00	0F	3198	00	0F
DQ	3058	FF	10	30D8	FF	10	3098	FF	00	3198	FF	00
Q	3050	00	03	30D0	00	03	3090	00	07	3190	00	07
DQ	3050	FF	18	30D0	FF	18	3090	FF	10	3190	FF	10
Q	3070	00	03	30F0	00	03	30B0	00	07	31B0	00	07
DQ	3070	FF	18	30F0	FF	18	30B0	FF	10	31B0	FF	10
Q	3060	00	01	30E0	00	01	30A0	00	03	31A0	00	03
DQ	3060	FF	1C	30E0	FF	1C	30A0	FF	18	31A0	FF	18

	Block 30 Hex			Block 31 Hex			Block 32 Hex			Block 33 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	3100	00	07	3300	00	07	3200	00	07	3600	00	07
DQ	3100	FF	10	3300	FF	10	3200	FF	10	3600	FF	10
Q	3101	01	1F	3301	01	1F	3201	01	1F	3601	01	1F
DQ	3101	FC	00	3301	FC	00	3201	FC	00	3601	FC	00
Q	3103	01	1F	3303	01	1F	3203	01	1F	3603	01	1F
DQ	3103	FC	00	3303	FC	00	3203	FC	00	3603	FC	00
Q	3102	01	1F	3302	01	1F	3202	01	1F	3602	01	1F
DQ	3102	FC	00	3302	FC	00	3202	FC	00	3602	FC	00
Q	3106	01	1F	3306	01	1F	3206	01	1F	3606	01	1F
DQ	3106	FC	00	3306	FC	00	3206	FC	00	3606	FC	00
Q	3104	00	1F	3304	01	1F	3204	00	0F	3604	00	0F
DQ	3104	FE	00	3304	FE	00	3204	FF	00	3604	FF	00
Q	310C	00	1F	330C	01	1F	320C	00	0F	360C	00	0F
DQ	310C	FE	00	330C	FE	00	320C	FF	00	360C	FF	00
Q	3108	00	0F	3308	00	0F	3208	00	0F	3608	00	0F
DQ	3108	FF	00	3308	FF	00	3208	FF	00	3608	FF	00
Q	3118	00	0F	3318	00	0F	3218	00	0F	3618	00	0F
DQ	3118	FF	00	3318	FF	00	3218	FF	00	3618	FF	00
Q	3110	00	07	3310	00	07	3210	00	0F	3610	00	0F
DQ	3110	FF	10	3310	FF	10	3210	FF	00	3610	FF	00
Q	3130	00	07	3330	00	07	3230	00	0F	3630	00	0F
DQ	3130	FF	10	3330	FF	10	3230	FF	00	3630	FF	00
Q	3120	00	07	3320	00	07	3220	00	07	3620	00	07
DQ	3120	FF	10	3320	FF	10	3220	FF	10	3620	FF	10

APPENDIX 1

	Block 34 Hex			Block 35 Hex			Block 36 Hex			Block 37 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	3400	00	07	3C00	00	07	3800	00	07	0000	01	1F
DQ	3400	FF	10	3C00	FF	10	3800	FF	10	0000	FC	00
Q	3401	01	1F	3C01	01	1F	3801	01	1F	0001	00	1F
DQ	3401	FC	00	3C01	FC	00	3801	FC	00	0001	FE	00
Q	3403	01	1F	3C03	01	1F	3803	01	1F	0003	00	1F
DQ	3403	FC	00	3C03	FC	00	3803	FC	00	0003	FE	00
Q	3402	01	1F	3C02	01	1F	3802	01	1F	0002	00	0F
DQ	3402	FC	00	3C02	FC	00	3802	FC	00	0002	FF	00
Q	3406	01	1F	3C06	01	1F	3806	01	1F	0006	00	0F
DQ	3406	FC	00	3C06	FC	00	3806	FC	00	0006	FF	00
Q	3404	00	0F	3C04	00	1F	3804	01	1F	0004	00	07
DQ	3404	FF	00	3C04	FE	00	3804	FC	00	0004	FF	10
Q	340C	00	0F	3C0C	00	1F	380C	01	1F	000C	00	07
DQ	340C	FF	00	3C0C	FE	00	380C	FC	00	000C	FF	10
Q	3408	00	0F	3C08	00	1F	3808	01	1F	0008	00	03
DQ	3408	FF	00	3C08	FE	00	3808	FC	00	0008	FF	18
Q	3418	00	0F	3C18	00	1F	3818	01	1F	0018	00	03
DQ	3418	FF	00	3C18	FE	00	3818	FC	00	0018	FF	18
Q	3410	00	07	3C10	00	1F	3810	01	1F	0010	00	01
DQ	3410	FF	00	3C10	FE	00	3810	FC	00	0010	FF	1C
Q	3430	00	07	3C30	00	1F	3830	01	1F	0030	00	01
DQ	3430	FF	00	3C30	FE	00	3830	FC	00	0030	FF	1C
Q	3420	00	07	3C20	00	1F	3820	01	1F	0020	00	00
DQ	3420	FF	00	3C20	FE	00	3820	FC	00	0020	FF	1E

	Block 38 Hex			Block 39 Hex			Block 40 Hex			Block 41 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0040	03	1F	00C0	03	1F	0080	07	1F	0180	07	1F
DQ	0040	F8	00	00C0	F8	00	0080	F0	00	0180	F0	00
Q	0041	01	1F	00C1	01	1F	0081	03	1F	0181	03	1F
DQ	0041	FC	00	00C1	FC	00	0081	F8	00	0181	F8	00
Q	0043	01	1F	00C3	01	1F	0083	03	1F	0183	03	1F
DQ	0043	FC	00	00C3	FC	00	0083	F8	00	0183	F8	00
Q	0042	00	1F	00C2	00	1F	0082	01	1F	0182	01	1F
DQ	0042	FE	00	00C2	FE	00	0082	FC	00	0182	FC	00
Q	0046	00	1F	00C6	00	1F	0086	01	1F	0186	01	1F
DQ	0046	FE	00	00C6	FE	00	0086	FC	00	0186	FC	00
Q	0044	00	0F	00C4	00	0F	0084	00	1F	0184	00	1F
DQ	0044	FF	00	00C4	FF	00	0084	FE	00	0184	FE	00
Q	004C	00	0F	00CC	00	0F	008C	00	1F	018C	00	1F
DQ	004C	FF	00	00CC	FF	00	008C	FE	00	018C	FE	00
Q	0048	00	07	00C8	00	07	0088	00	0F	0188	00	0F
DQ	0048	FF	00	00C8	FF	10	0088	FF	00	0188	FF	00
Q	0018	00	07	00D8	00	07	0098	00	0F	0198	00	0F
DQ	0018	FF	00	00D8	FF	10	0098	FF	00	0198	FF	00
Q	0010	00	03	00D0	00	03	0090	00	07	0190	00	07
DQ	0010	FF	18	00D0	FF	18	0090	FF	10	0190	FF	10
Q	0030	00	03	00F0	00	03	00B0	00	07	01B0	00	07
DQ	0030	FF	18	00F0	FF	18	00B0	FF	10	01B0	FF	10
Q	0020	00	01	00E0	00	01	00A0	00	03	01A0	00	03
DQ	0020	FF	1C	00E0	FF	1C	00A0	FF	18	01A0	FF	18

APPENDIX 1

	Block 42 Hex			Block 43 Hex			Block 44 Hex			Block 45 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0100	0F	1F	0300	0F	1F	0200	1F	1F	0600	1F	1F
DQ	0100	E0	00	0300	E0	00	0200	C0	00	0600	C0	00
Q	0101	07	1F	0301	07	1F	0201	0F	1F	0601	0F	1F
DQ	0101	F0	00	0301	F0	00	0201	E0	00	0601	E0	00
Q	0103	07	1F	0303	07	1F	0203	0F	1F	0603	0F	1F
DQ	0103	F0	00	0303	F0	00	0203	E0	00	0603	E0	00
Q	0102	03	1F	0302	03	1F	0202	07	1F	0602	07	1F
DQ	0102	F8	00	0302	F8	00	0202	F0	00	0602	F0	00
Q	0106	03	1F	0306	03	1F	0206	07	1F	0606	07	1F
DQ	0106	F8	00	0306	F8	00	0206	F0	00	0606	F0	00
Q	0104	01	1F	0304	01	1F	0204	03	1F	0604	03	1F
DQ	0104	FC	00	0304	FC	00	0204	F8	00	0604	F8	00
Q	010C	01	1F	030C	01	1F	020C	03	1F	060C	03	1F
DQ	010C	FC	00	030C	FC	00	020C	F8	00	060C	F8	00
Q	0108	00	1F	0308	00	1F	0208	01	1F	0608	01	1F
DQ	0108	FE	00	0308	FE	00	0208	FC	00	0608	FC	00
Q	0118	00	1F	0318	00	1F	0218	01	1F	0618	01	1F
DQ	0118	FE	00	0318	FE	00	0218	FC	00	0618	FC	00
Q	0110	00	0F	0310	00	0F	0210	00	1F	0610	00	1F
DQ	0110	FF	00	0310	FF	00	0210	FE	00	0610	FE	00
Q	0130	00	0F	0330	00	0F	0230	00	1F	0630	00	1F
DQ	0130	FF	00	0330	FF	00	0230	FE	00	0630	FE	00
Q	0120	00	07	0320	00	07	0220	00	0F	0620	00	0F
DQ	0120	FF	10	0320	FF	10	0220	FF	00	0620	FF	00

	Block 46 Hex			Block 47 Hex			Block 48 Hex			Block 49 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	0400	3F	1F	0C00	3F	1F	0800	7F	1F	4000	00	00
DQ	0400	80	00	0C00	80	00	0800	00	00	4000	00	00
Q	0401	1F	1F	0C01	1F	1F	0801	3F	1F	4001	00	00
DQ	0401	C0	00	0C01	C0	00	0801	80	00	4001	FF	1E
Q	0403	1F	1F	0C03	1F	1F	0803	3F	1F	4003	00	03
DQ	0403	C0	00	0C03	C0	00	0803	80	00	4003	FF	18
Q	0402	0F	1F	0C02	0F	1F	0802	1F	1F	4002	00	0F
DQ	0402	E0	00	0C02	E0	00	0802	C0	00	4002	FF	00
Q	0406	0F	1F	0C06	0F	1F	0806	1F	1F	4006	01	1F
DQ	0406	E0	00	0C06	E0	00	0806	C0	00	4006	FC	00
Q	0404	07	1F	0C04	07	1F	0804	0F	1F	4004	01	1F
DQ	0404	F0	00	0C04	F0	00	0804	E0	00	4004	FC	00
Q	040C	07	1F	0C0C	07	1F	080C	0F	1F	400C	01	1F
DQ	040C	F0	00	0C0C	F0	00	080C	E0	00	400C	FC	00
Q	0408	03	1F	0C08	03	1F	0808	07	1F	4008	01	1F
DQ	0408	F8	00	0C08	F8	00	0808	F0	00	4008	FC	00
Q	0418	03	1F	0C18	03	1F	0818	07	1F	4018	01	1F
DQ	0418	F8	00	0C18	F8	00	0818	F0	00	4018	FC	00
Q	0410	01	1F	0C10	01	1F	0810	03	1F	4010	07	1F
DQ	0410	FC	00	0C10	FC	00	0810	F8	00	4010	F0	00
Q	0430	01	1F	0C30	01	1F	0830	03	1F	4030	1F	1F
DQ	0430	FC	00	0C30	FC	00	0830	F8	00	4030	C0	00
Q	0420	00	1F	0C20	00	1F	0820	01	1F	4020	1F	1F
DQ	0420	FE	00	0C20	FC	00	0820	FC	00	4020	00	00

APPENDIX 1

	Block 50 Hex			Block 51 Hex			Block 52 Hex			Block 53 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	4041	7F	1F	40C1	3F	1F	4081	1F	1F	4181	0F	1F
DQ	4041	00	00	40C1	80	00	4081	C0	00	4181	E0	00
Q	4043	7F	1F	40C3	3F	1F	4083	1F	1F	4183	0F	1F
DQ	4043	00	00	40C3	80	00	4083	C0	00	4183	E0	00
Q	4042	7F	1F	40C2	3F	1F	4082	1F	1F	4182	0F	1F
DQ	4042	00	00	40C2	80	00	4082	C0	00	4182	E0	00
Q	4046	7F	1F	40C6	3F	1F	4086	1F	1F	4186	0F	1F
DQ	4046	00	00	40C6	80	00	4086	C0	00	4186	E0	00
Q	4044	7F	1F	40C4	3F	1F	4084	1F	1F	4184	0F	1F
DQ	4044	00	00	40C4	80	00	4084	C0	00	4184	E0	00
Q	404C	7F	1F	40CC	3F	1F	408C	1F	1F	418C	0F	1F
DQ	404C	00	00	40CC	80	00	408C	C0	00	418C	E0	00
Q	4241	7F	1F	42C1	3F	1F	4281	1F	1F	4381	0F	1F
DQ	4241	00	00	42C1	80	00	4281	C0	00	4381	E0	00
Q	4243	7F	1F	42C3	3F	1F	4283	1F	1F	4383	0F	1F
DQ	4243	00	00	42C3	80	00	4283	C0	00	4383	E0	00
Q	4242	7F	1F	42C2	3F	1F	4282	1F	1F	4382	0F	1F
DQ	4242	00	00	42C2	80	00	4282	C0	00	4382	E0	00
Q	4246	7F	1F	42C6	3F	1F	4286	1F	1F	4386	0F	1F
DQ	4246	00	00	42C6	80	00	4286	C0	00	4386	E0	00
Q	4244	7F	1F	42C4	3F	1F	4284	1F	1F	4384	0F	1F
DQ	4244	00	00	42C4	80	00	4284	C0	00	4384	E0	00
Q	424C	7F	1F	42CC	3F	1F	428C	1F	1F	438C	0F	1F
DQ	424C	00	00	42CC	80	00	428C	C0	00	438C	E0	00
Q	4448	00	00	44C8	00	01	4488	00	03	4588	00	0F
DQ	4448	FF	1E	44C8	FF	1C	4488	FF	18	4588	FF	10
Q	4458	00	00	44D8	00	01	4498	00	03	4598	00	07
DQ	4458	FF	1E	44D8	FF	1C	4498	FF	18	4598	FF	10
Q	4450	00	00	44D0	00	01	4490	00	03	4590	00	07
DQ	4450	FF	1E	44D0	FF	1C	4490	FF	18	4590	FF	10
Q	4470	00	00	44F0	00	01	44B0	00	03	45B0	00	07
DQ	4470	FF	1E	44F0	FF	1C	44B0	FF	18	45B0	FF	10
Q	4460	00	00	44E0	00	01	44A0	00	03	45A0	00	07
DQ	4460	FF	1E	44E0	FF	1C	44A0	FF	18	45A0	FF	10

APPENDIX 1

	Block 54 Hex		
	A14-A0	13-6	5-1
Q	4101	07	1F
DQ	4101	F0	00
Q	4103	07	1F
DQ	4103	F0	00
Q	4102	07	1F
DQ	4102	F0	00
Q	4106	07	1F
DQ	4106	F0	00
Q	4104	07	1F
DQ	4104	F0	00
Q	410C	07	1F
DQ	410C	F0	00
Q	4301	07	1F
DQ	4301	F0	00
Q	4303	07	1F
DQ	4303	F0	00
Q	4302	07	1F
DQ	4302	F0	00
Q	4306	07	1F
DQ	4306	F0	00
Q	4304	07	1F
DQ	4304	F0	00
Q	430C	07	1F
DQ	430C	F0	00
Q	4508	00	0F
DQ	4508	FF	00
Q	4508	00	0F
DQ	4508	FF	00
Q	4500	00	0F
DQ	4500	FF	00
Q	45B0	00	0F
DQ	45B0	FF	00
Q	45A0	00	0F
DQ	45A0	FF	00

APPENDIX 1

	Block 55 Hex			Block 56 Hex			Block 57 Hex			Block 58 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	4000	7F	1F	4200	7F	1F	4600	7F	1F	4400	7F	1F
DQ	4000	00	00	4200	00	00	4600	00	00	4400	00	00
Q	4001	7F	1F	4201	7F	1F	4601	7E	1F	4401	7F	1F
DQ	4001	00	00	4201	00	00	4601	00	00	4401	00	00
Q	4003	1F	1F	4203	1F	1F	4603	1F	1F	4403	1F	1F
DQ	4003	C0	00	4203	C0	00	4603	C0	00	4403	C0	00
Q	4002	07	1F	4202	07	1F	4602	07	1F	4402	07	1F
DQ	4002	F0	00	4202	F0	00	4602	F0	00	4402	F0	00
Q	4006	01	1F	4206	00	1F	4606	00	0F	4406	00	07
DQ	4006	FC	00	4206	FE	00	4606	FF	00	4406	FF	10
Q	4004	01	1F	4204	00	1F	4604	00	0F	4404	00	07
DQ	4004	FC	00	4204	FE	00	4604	FF	00	4404	FF	10
Q	400C	01	1F	420C	00	1F	460C	00	0F	440C	00	07
DQ	400C	FC	00	420C	FE	00	460C	FF	00	440C	FF	10
Q	4008	01	1F	4208	00	1F	4608	00	0F	4408	00	07
DQ	4008	FC	00	4208	FE	00	4608	FF	00	4408	FF	10
Q	4018	01	1F	4218	00	1F	4618	00	0F	4418	00	07
DQ	4018	FC	00	4218	FE	00	4618	FF	00	4418	FF	10
Q	4010	00	0F	4210	00	0F	4610	00	0F	4410	00	0F
DQ	4010	FF	00	4210	FF	00	4610	FF	00	4410	FF	00
Q	4030	00	03	4230	00	03	4630	00	03	4430	00	03
DQ	4030	FF	18	4230	FF	18	4630	FF	18	4430	FF	18
Q	4020	00	00	4220	00	00	4620	00	00	4420	00	00
DQ	4020	FF	1E	4220	FF	1E	4620	FF	1E	4420	FF	1E

	Block 59 Hex			Block 60 Hex			Block 61 Hex			Block 62 Hex		
	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1	A14 - A0	13-6	5-1
Q	4C00	7F	1F	4800	7F	1F	5800	7F	1F	5000	7F	1F
DQ	4C00	00	00	4800	00	00	5800	00	00	5000	00	00
Q	4C01	7F	1F	4801	7F	1F	5801	7F	1F	5001	7F	1F
DQ	4C01	00	00	4801	00	00	5801	00	00	5001	00	00
Q	4C03	1F	1F	4803	1F	1F	5803	1F	1F	5003	1F	1F
DQ	4C03	C0	00	4803	C0	00	5803	C0	00	5003	C0	00
Q	4C02	07	1F	4802	07	1F	5802	07	1F	5002	07	1F
DQ	4C02	F0	00	4802	F0	00	5802	F0	00	5002	F0	00
Q	4C06	00	03	4806	00	01	5806	00	00	5006	00	00
DQ	4C06	FF	18	4806	FF	1C	5806	FF	1E	5006	FF	1E
Q	4C04	00	03	4804	00	01	5804	00	00	5004	00	00
DQ	4C04	FF	18	4804	FF	1C	5804	FF	1E	5004	FF	1E
Q	4C0C	00	03	480C	00	01	580C	00	00	500C	00	00
DQ	4C0C	FF	18	480C	FF	1C	580C	FF	1E	500C	FF	1E
Q	4C08	00	03	4808	00	01	5808	00	00	5008	00	00
DQ	4C08	FF	18	4808	FF	1C	5808	FF	1E	5008	FF	1E
Q	4C18	00	03	4818	00	01	5818	00	00	5018	00	00
DQ	4C18	FF	18	4818	FF	1C	5818	FF	1E	5018	FF	1E
Q	4C10	00	0F	4810	00	0F	5810	00	0F	5010	00	0F
DQ	4C10	FF	00	4810	FF	00	5810	FF	00	5010	FF	00
Q	4C30	00	03	4830	00	03	5830	00	03	5030	00	03
DQ	4C30	FF	18	4830	FF	18	5830	FF	18	5030	FF	18
Q	4C20	00	00	4820	00	00	5820	00	00	5020	00	00
DQ	4C20	FF	1E	4820	FF	1E	5820	FF	1E	5020	FF	1E

APPENDIX 1

CLAIMS

1. A system for controlling one or more actuators for providing movement of a simulator assembly, said system including:

processing means for processing movement request signals generated from a movement signalling means to thereby provide one or more actuator position request signals;

actuator control means in communication with said processing means to thereby receive said one or more position request signals and control directional movement of said one or more actuators in accordance with said one or more position request signals; and

actuator position detection means for detecting when one or more actuators have reached a requested position in accordance of said one or more position request signals,

wherein said system is characterised such that in use when said position detection means detects that the requested position has been reached, said actuator control means disallows movement of said one or more actuators until another one of said movement request signals is generated.

2. A system as claimed in claim 1, wherein said actuator control means includes a plurality of position control switching means activatable by said actuator position detection means.

3. A system as claimed in claim 1, wherein said actuator control means include sets of spaced conductive pads arranged to be selectively electrically coupled to a respective conductive pickup means of said actuator position detection means.

4. A system as claimed in claim 1, wherein said actuator control means includes sets of spaced light emitting diodes arranged to be selectively coupled to a respective sensor wherein said actuator position detection means is adapted to selectively affect the coupling of the diodes.

5. A system as claimed in claim 1, wherein said control means includes:

first control means associated with a first one of said actuators for controlling directional movement thereof; and

second control means associated with a second one of said actuators for controlling directional movement thereof.

6. A system as claimed in claim 1, wherein the control means includes a third control means associated with a third one of said actuators for

controlling directional movement thereof.

7. A system as claimed in claim 1, wherein, said actuator position detection means includes:

first position detection means associated with said first position control means; and

second position detection means associated with said second position control means.

8. A system as claimed in claim 7, wherein the actuator position detection means includes a third position detection means associated with said third position control means.

9. A system as claimed in claim 7, wherein said first and said second position detection means are operatively coupled to a respective actuator of the simulator assembly.

10. A system as claimed in claim 8, wherein said third position detection means is operatively coupled to a respective actuator of a simulator assembly.

11. A system as claimed in claim 1, wherein said movement signalling means is in communication with said processing means.

12. A system as claimed in claim 1, wherein said movement signalling means is controllable by a person using said simulator assembly.

13. A system as claimed in claim 1, wherein said movement signalling means comprises a plurality of switch means for generating digitised said request signals, wherein at least two of said switch means are arranged to be actuated.

14. A system as claimed in claim 1, wherein said movement signalling means comprises one or more variable resistors for generating one or more analogue signals; and one or more analogue to digital conversion means coupled to one or more said variable resistor(s) for providing digital request signal(s) corresponding to said one or more analogue signal(s).

15. A system as claimed in claim 1, wherein said movement signalling means includes processor signalling means for providing one or more processor signals to a processor adapted to control graphical simulation representations displayed on a visual display unit in response to said processor signals.

16. A method for controlling one or more actuators for providing movement of a simulator assembly in conjunction with representations on a

visual display unit, said representations being determined by interactive graphical software adapted to respond to signals generated from a user controllable movement signalling means, said method including the steps of:

processing movement request signals generated from the movement signalling means to thereby provide one or more actuator position request signals; and

controlling directional movement of said one or more actuators in accordance with said one or more position request signals,

wherein the step of controlling directional movement is effected independently of said software.

17. A method for controlling one or more actuators of a simulator assembly, said method including the steps of:

processing digital movement request signals to provide one or more actuator position request signals;

controlling directional movement of said one or more actuators in accordance with said one or more actuator position request signals; and

detecting when said one or more actuators have reached a requested position in accordance of said one or more position request signals, wherein when the step of detecting determines that said one or more actuators have reached said requested position movement thereof is disallowed until a different one of said movement request signals is processed.

18. A method as claimed in claim 17 further characterised by the prior step of generating said digital movement request signals in response to activation of a user controlled signalling means, said user controlled signalling means also providing signals to interactive graphical software.

19. A user controllable movement signalling means for controlling one or more actuators of a simulator assembly, the movement signalling means being adapted to provide two signals one of which is for interacting with graphical software for providing visual representation on a visual display unit and the other of the signals being a digital signal for controlling directional movement of said one or more actuators.

20. A system for controlling one or more actuators for providing movement of a simulator assembly in conjunction with representations on a visual display unit, said representations being determined by interactive graphical software adapted to respond to signals generated from a user

controllable movement signalling means, said system including:

processing means for processing movement request signals generated from a movement signalling means to thereby provide one or more actuator position request signals; and

actuator control means in communication with said processing means to thereby receive said one or more position request signals and control directional movement of said one or more actuators in accordance with said one or more position request signals,

wherein said system is adapted to control directional movement of said one or more actuators independently of said software.

21. A system as claimed in claim 20, wherein there are actuator position detection means associated with said one or more actuators for detecting when said one or more actuators have reached a requested position in accordance of said one or more position request signals.

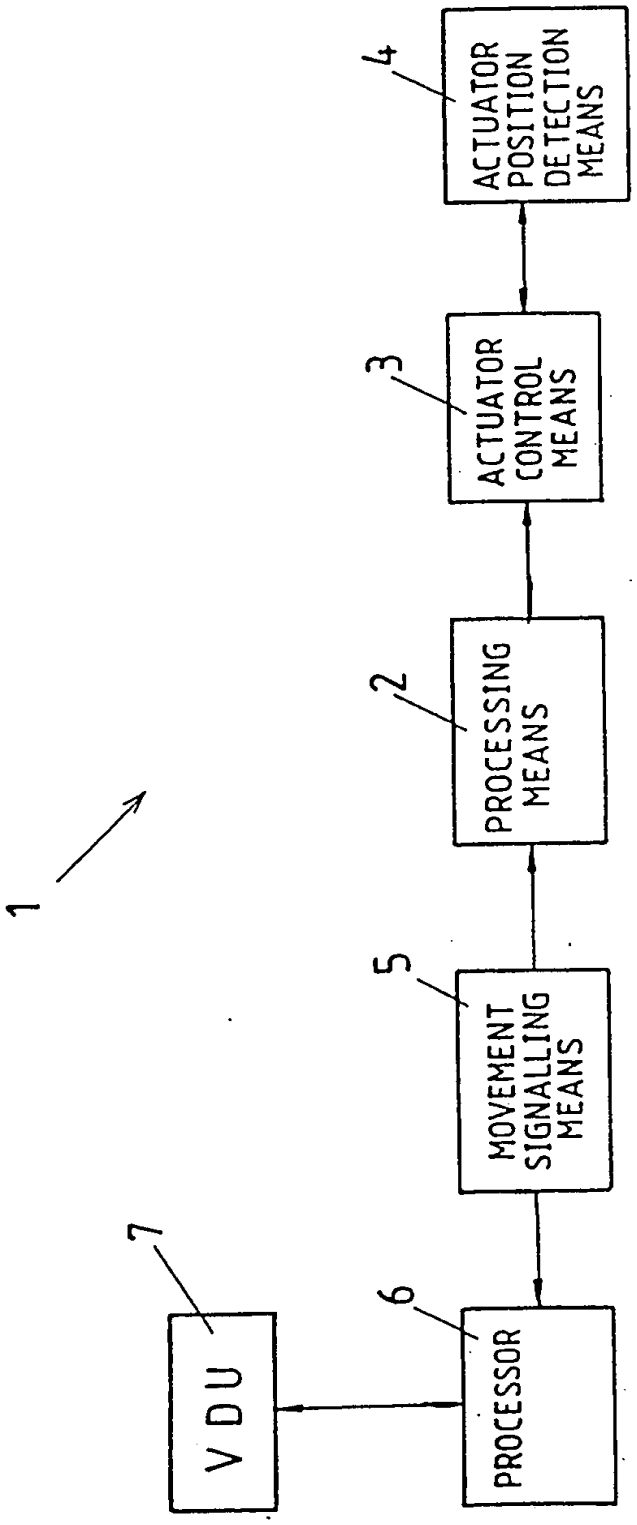

1
2
PROCESSING MEANS
3
ACTUATOR CONTROL MEANS
4
ACTUATOR POSITION DETECTION MEANS
5
MOVEMENT SIGNALLING MEANS
6
PROCESSOR
7
VDU

FIG. 1

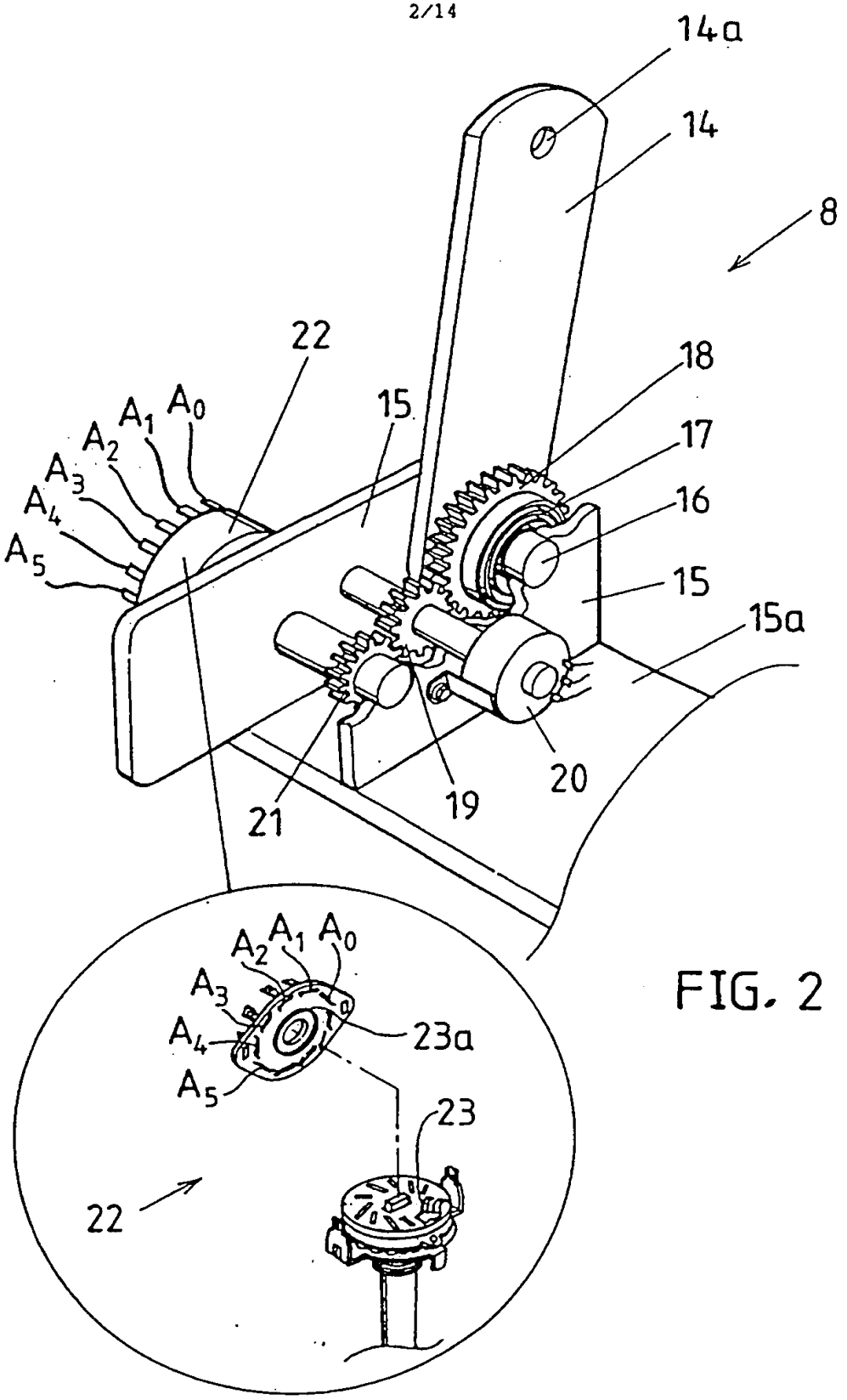


FIG. 2

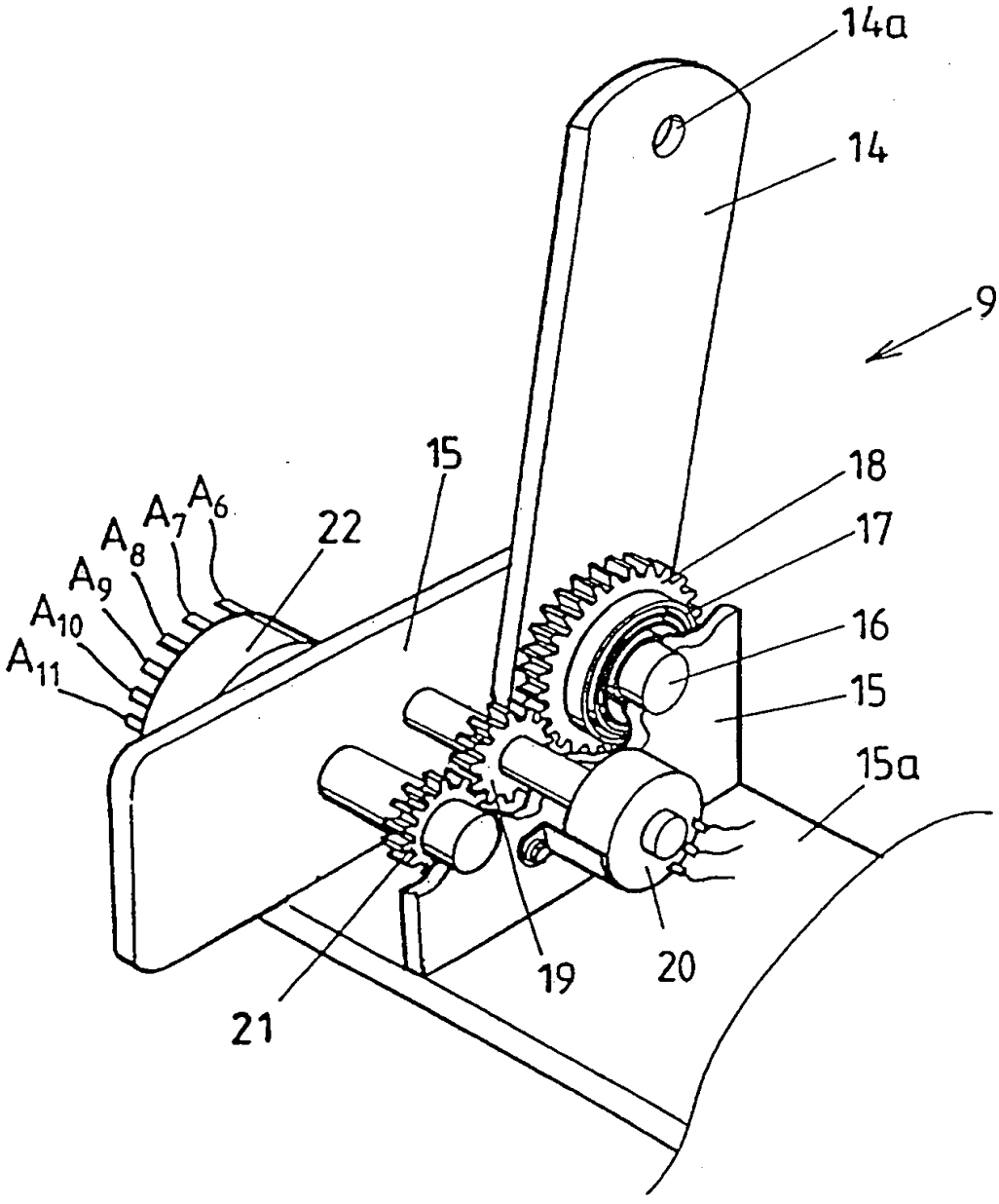


FIG. 3

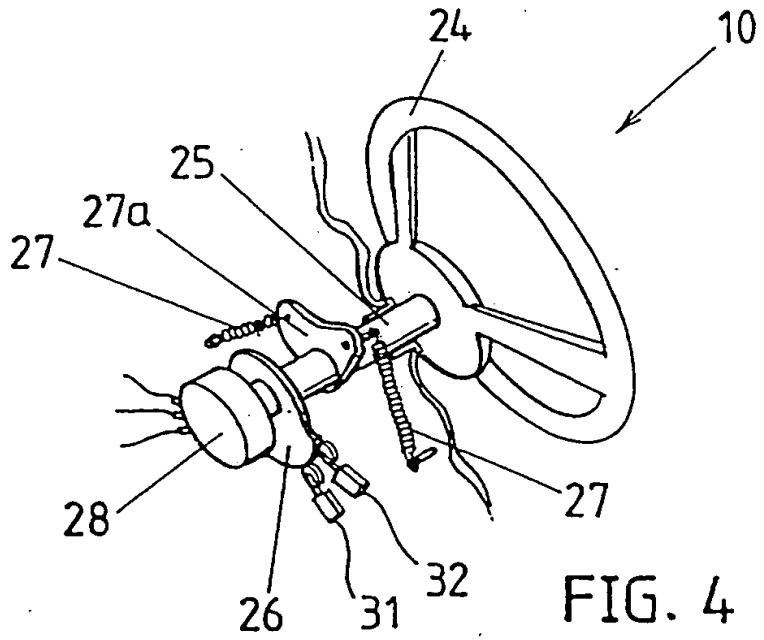

24
10
25
27a
27
28
27
26
31
32

FIG. 4

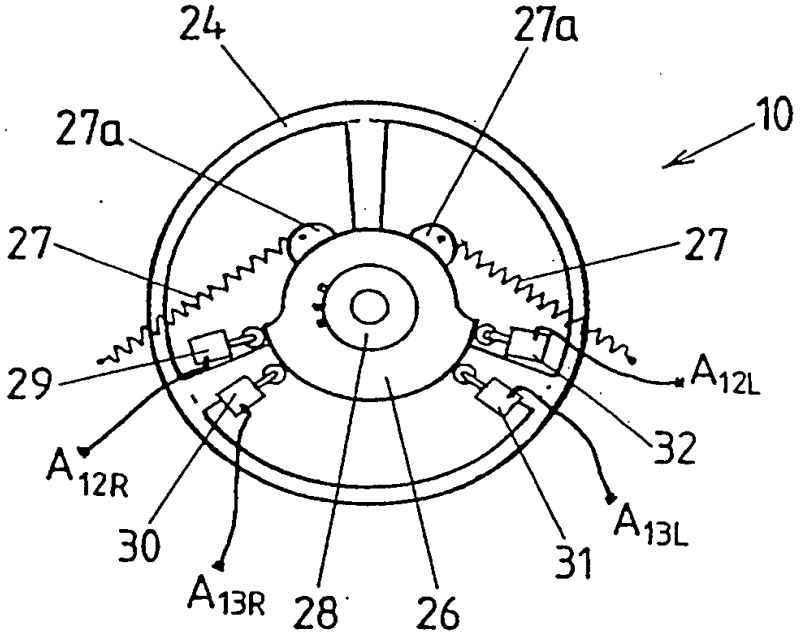

24
27a
27a
10
27
27
29
A_{12L}
A_{12R}
32
30
A_{13L}
31
A_{13R}
28
26

FIG. 5

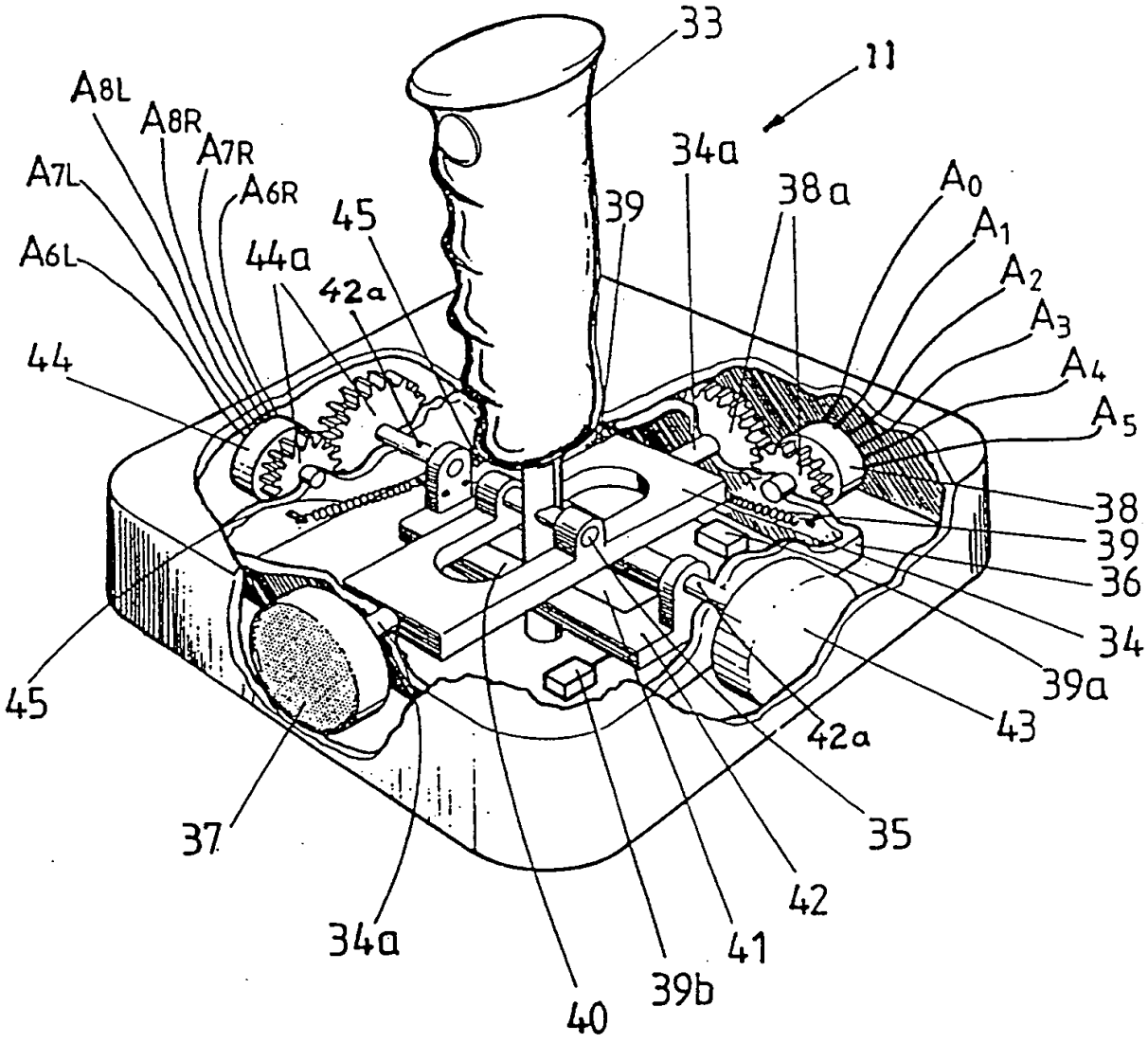

33
11
A8L
A8R
A7R
A7L
A6R
A6L
45
44a
42a
39
34a
38a
A0
A1
A2
A3
A4
A5
44
38
39
36
34
39a
43
42a
45
37
35
42
41
34a
39b
40

FIG. 6

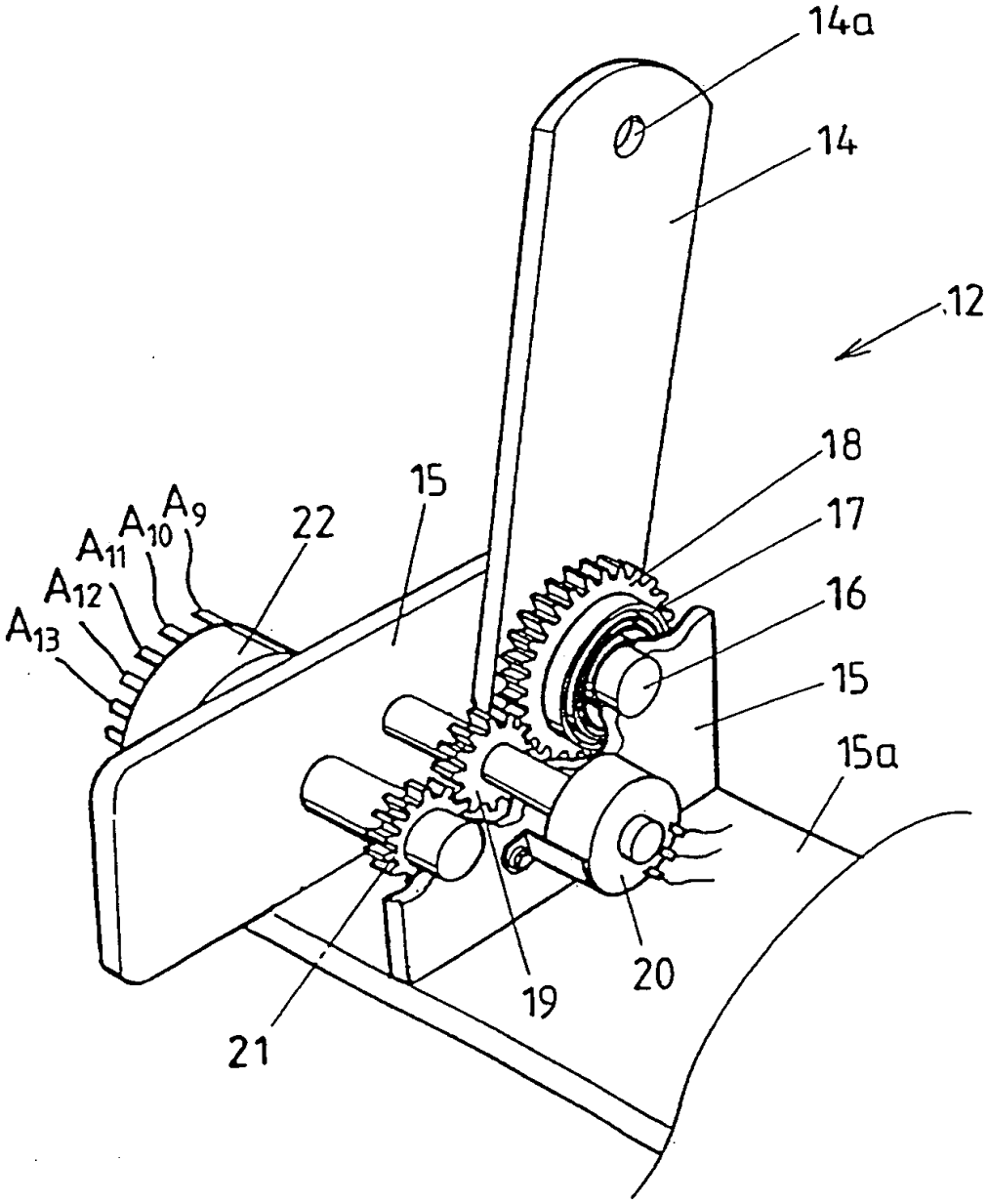
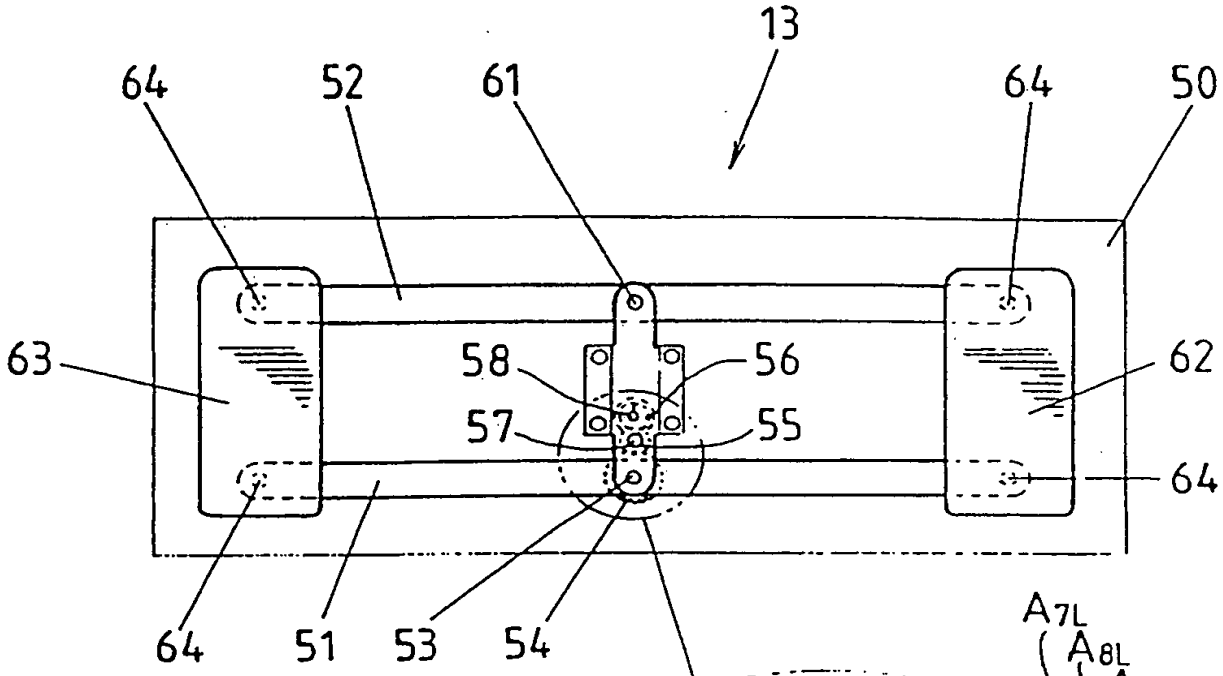


FIG. 7


13
64
52
61
64
50
63
58
56
62
57
55
64
64
51
53
54

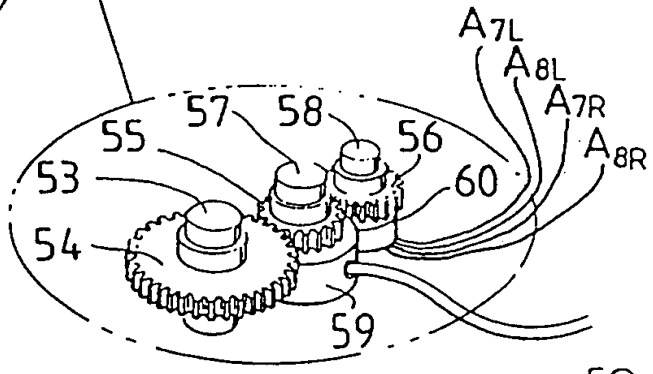

A7L
A8L
A7R
A8R
57
58
55
56
53
60
54
59

FIG. 8

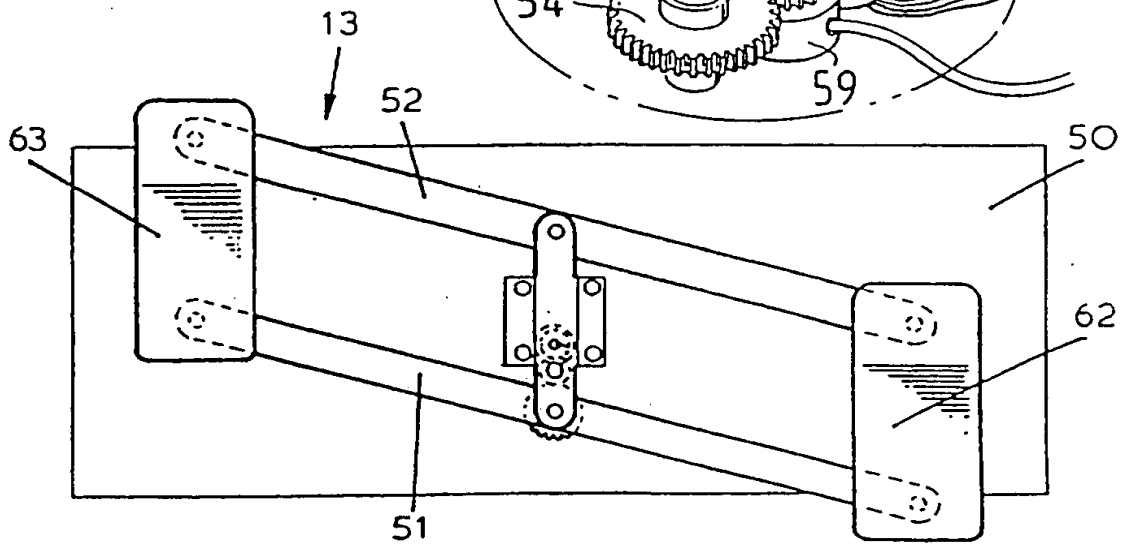

13
52
63
50
62
51

FIG. 9

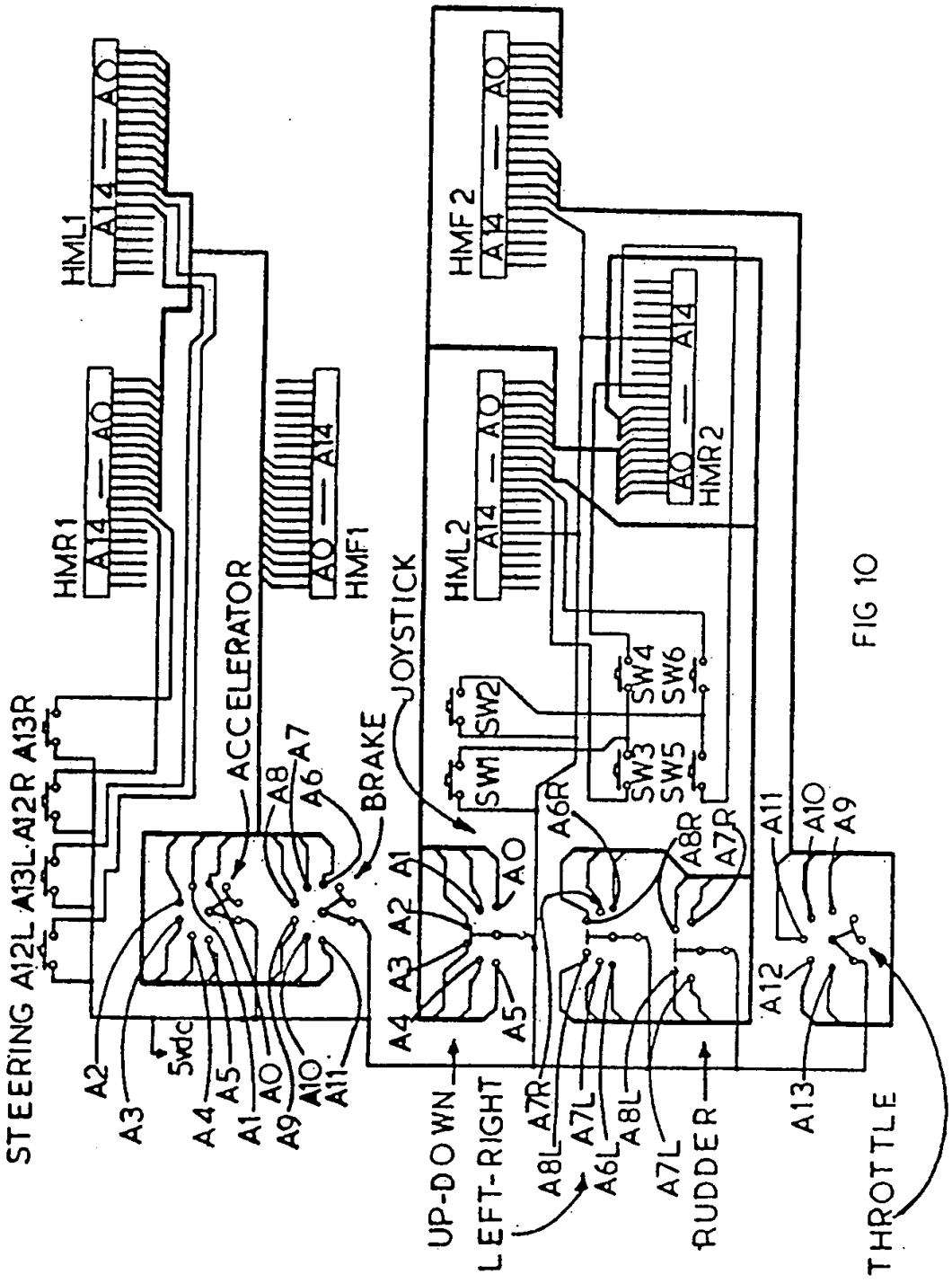

HML1
A14
A0
HMR1
HMF1
HMF2
HML2
HMR2
ACCELERATOR
BRAKE
JOYSTICK
SW1
SW2
SW3
SW4
SW5
SW6
STEERING
A12L
A13L
A12R
A13R
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A6R
A7R
A8R
A6L
A7L
A8L
5vdc
UP-DOWN
LEFT-RIGHT
RUDDER
THROTTLE

FIG 10

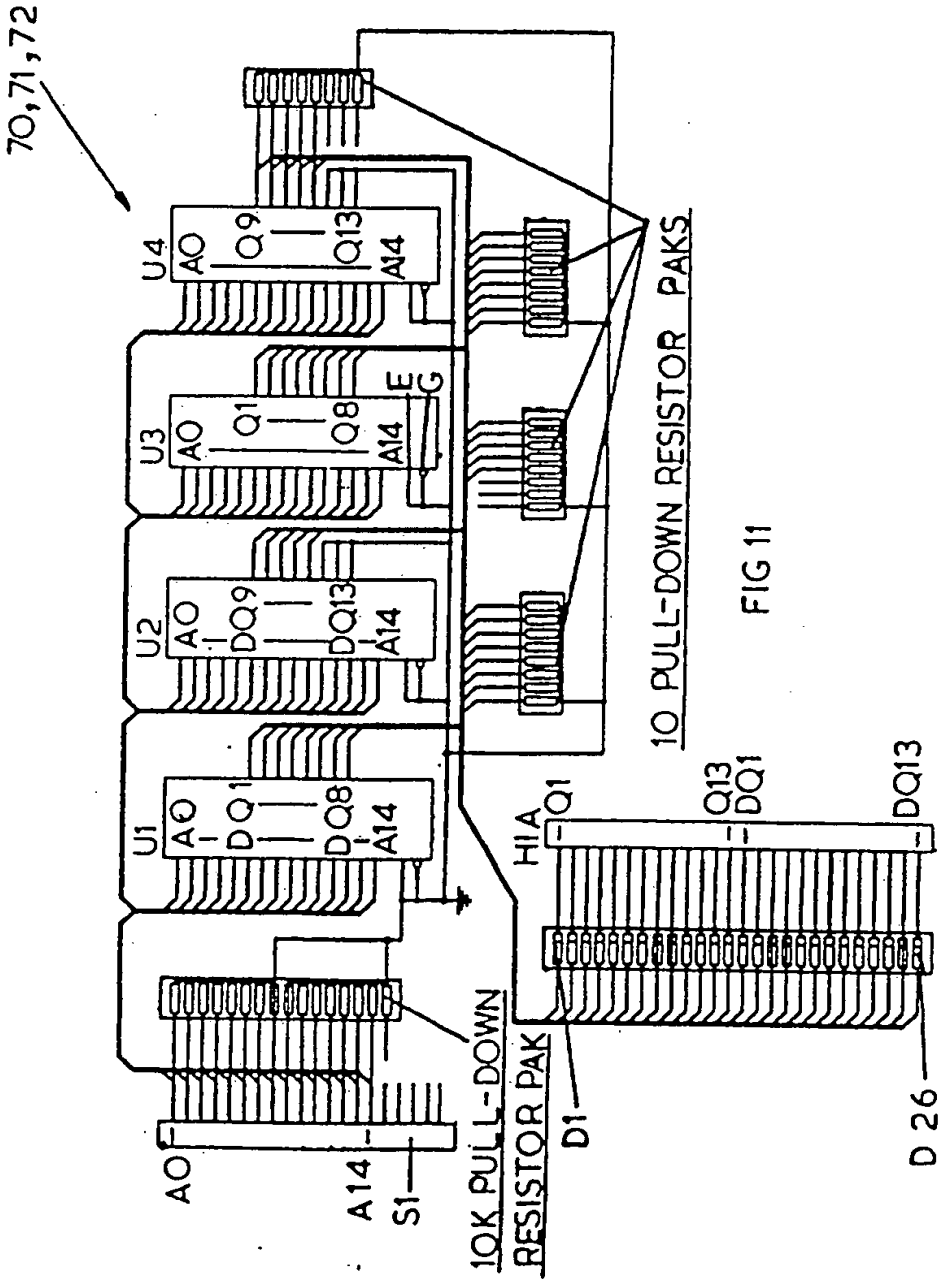

70,71,72
U4
U3
U2
U1
AO
A14
Q9
Q13
Q1
Q8
DQ9
DQ13
DQ1
DQ8
E
G
10 PULL-DOWN RESISTOR PAKS
H1A
Q13
DQ1
DQ13
D1
D 26
10K PULL-DOWN
RESISTOR PAK
S1

FIG 11

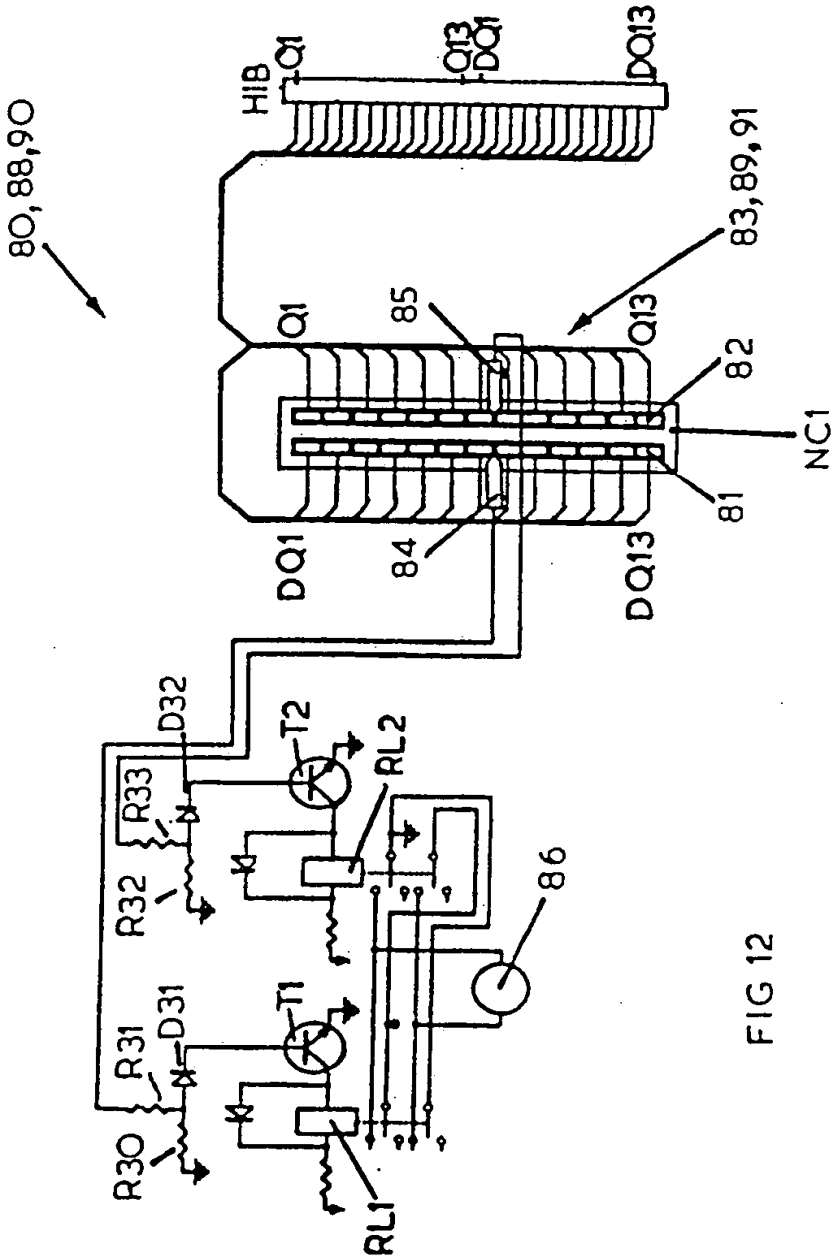

HIB
Q1
Q13
DQ1
DQ13
80, 88, 90
83, 89, 91
85
82
NC1
81
84
D32
T2
RL2
R33
R32
86
T1
D31
R31
R30
RL1

FIG 12

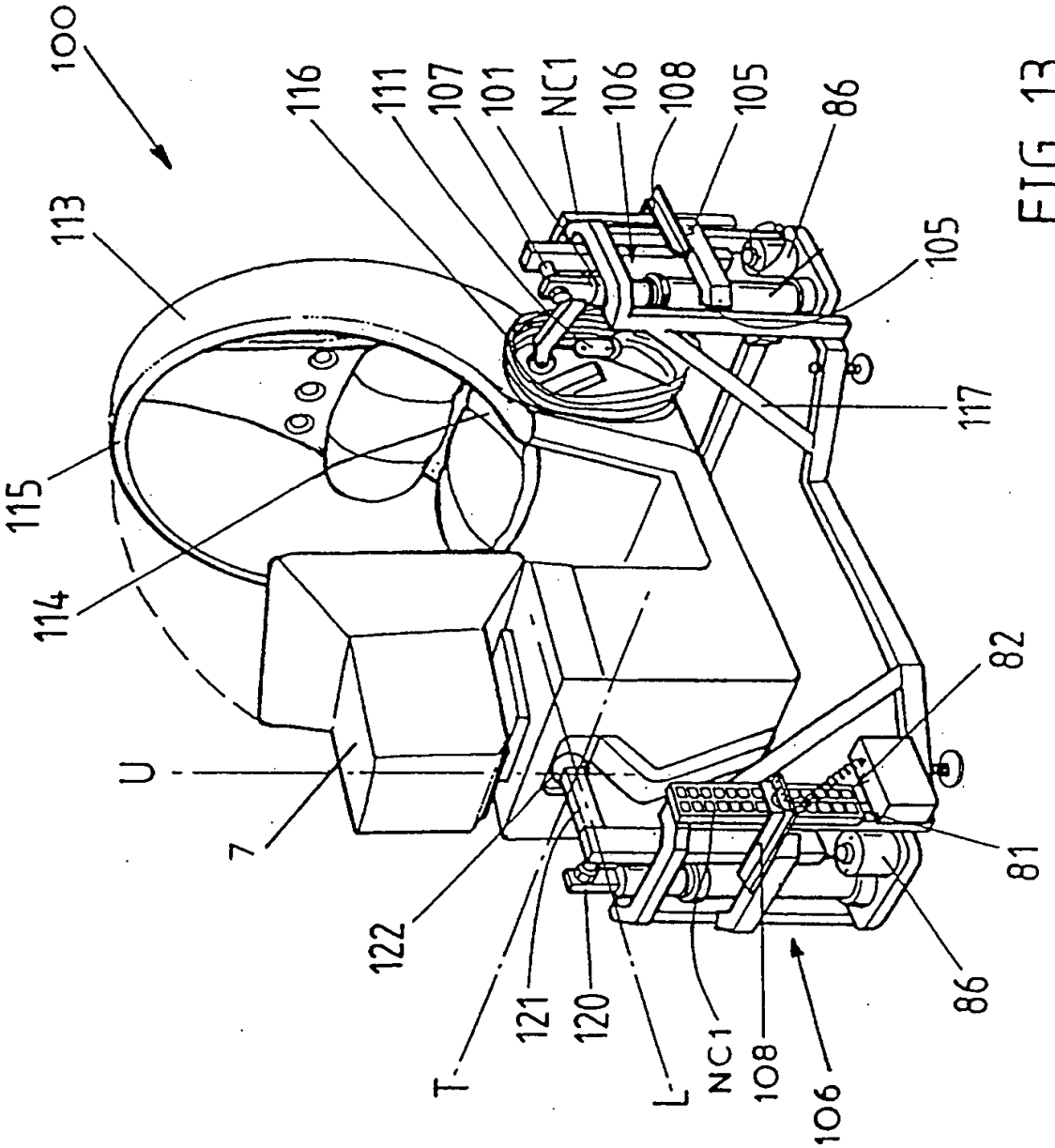

100
116
111
107
101
NC1
106
108
105
86
113
105
117
115
114
82
U
7
81
122
121
120
T
L
NC1
108
106
86

FIG. 13

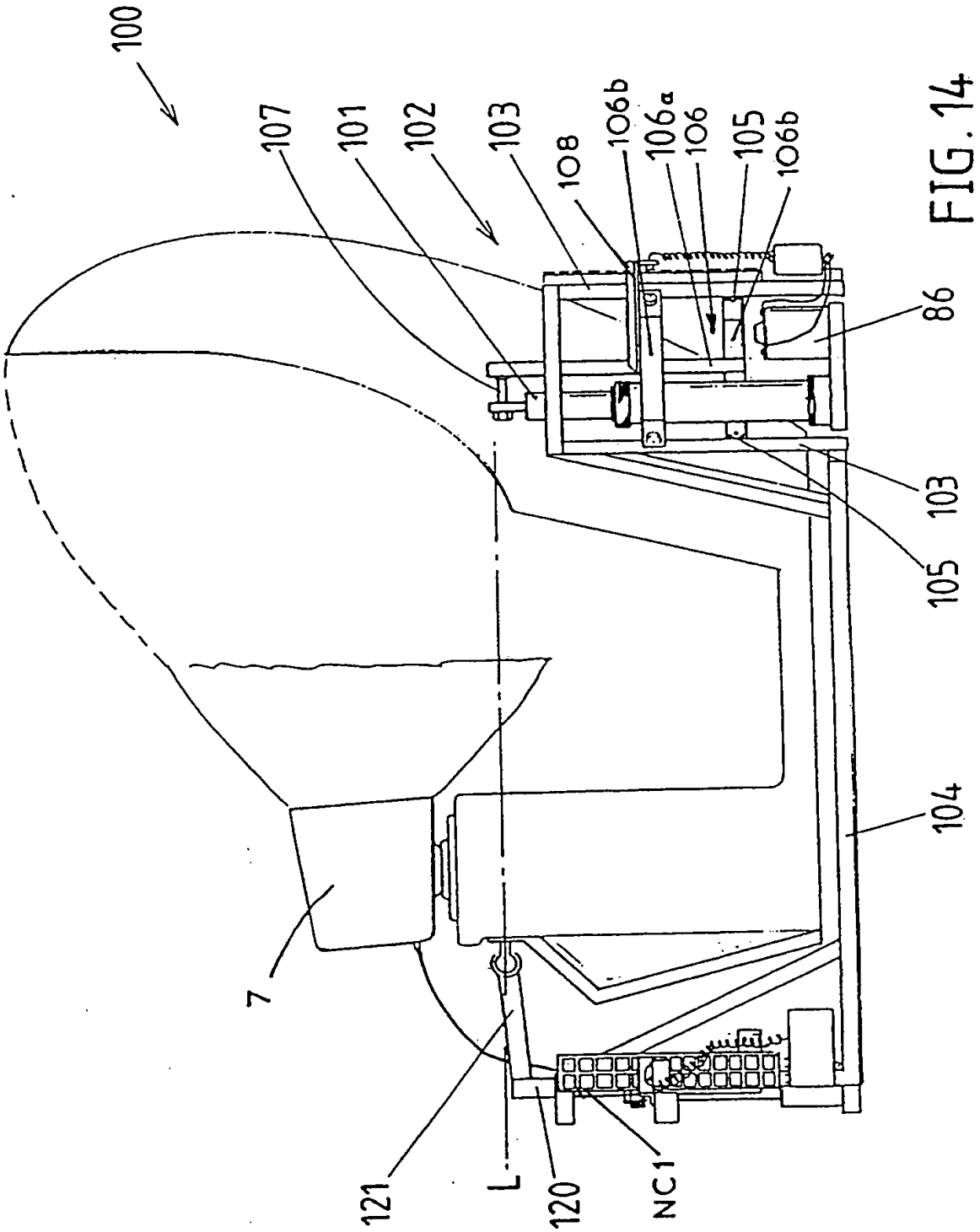

100
107
101
102
103
108
106b
106a
106
105
106b
86
103
105
104
7
121
L
120
NC1

FIG. 14

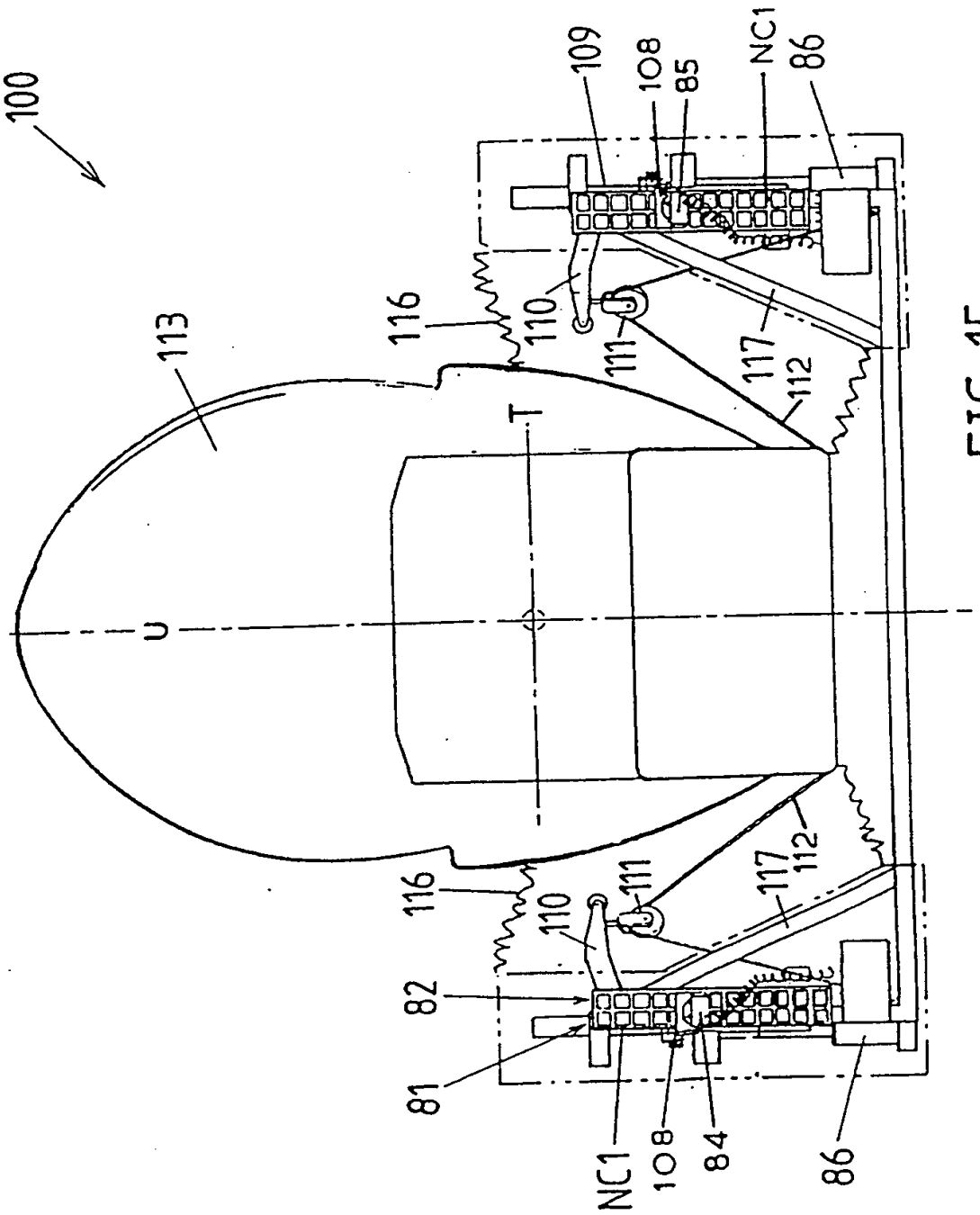


FIG. 15

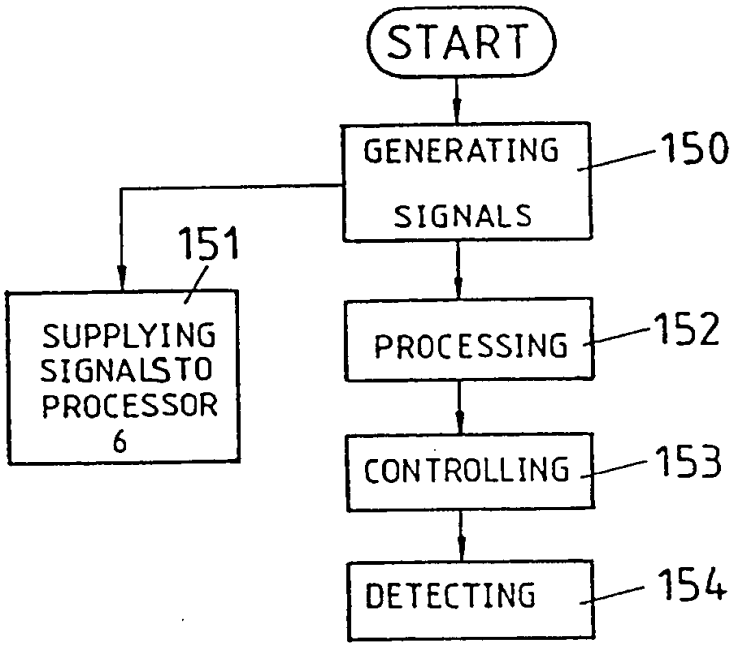

START
GENERATING SIGNALS
150
151
SUPPLYING SIGNALS TO PROCESSOR 6
PROCESSING
152
CONTROLLING
153
DETECTING
154

FIG. 16

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00643

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A63G 31/02, 31/16, G09B 9/02, G05B 17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : A63G 31/00, 31/02, 31/16, G09B 9/02, 9/04, 9/06, 9/14, G05B 17/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CASIS : Keywords : Simulator & (training or amusement)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	EP 0697229 A2 (KONAMI CO LTD) 21 February 1995 see entire document	1 to 21
X	US 5433670 (RIDEFILM CORPORATION) 18 July 1995 see entire document	1 to 21
X	AU 11963/95 A (DENNE DEVELOPMENTS LTD) 15 June 1995 see entire document	1 to 21

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 November 1996	26 Nov 1996
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer ROBERT BARTRAM Telephone No.: (06) 283 2215

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00643

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

The specification does not comply with section 40(4). The claims do not relate to one invention only, because there is no common element of novelty between the invention defined by claims 1 to 15, 17 and 18 and the invention defined by claims 16 and 19 to 21. An investigation into the novelty of the former claim(s) would not establish the novelty of the latter claim(s) and vice versa.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00643

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 83/02028 A (JAMES, Christopher) 9 June 1983 see entire document	1 to 21
X	AU 48397/85 A (JAMES, Christopher; McDONOUGH, Colin) 17 April 1986 see entire document	1 to 21
X	US 4066256 A (TRUMBULL, Douglas) 3 January 1978 see entire document	1 to 21
X	WO 93/09482 (FIAT AUTO S.P.A.) 13 May 1993 see entire document	1 to 21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 96/00643

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	697229	JP	8052274				
US	5433670	WO	9621496				
AU	11963/95	EP GB	733253 9400303	GB GB	9411152 9325234	WO	9516253
WO	8302028	AU	10136/83	EP	94950		
WO	9309482	BR IT	9206881 91940839	DE WO	69213955 9309482	EP	611459

END OF ANNEX